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THE ICE-BREAKING STEAMER "ERMAK."

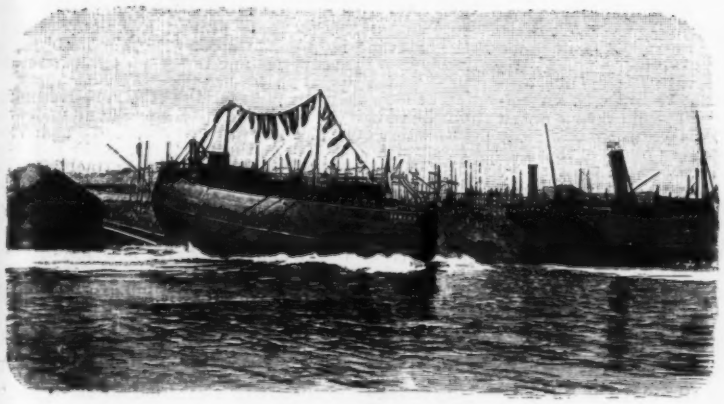
It will be remembered that the ship is 305 feet long, 71 feet wide, and 42 feet 6 inches deep. The four screws by which she is propelled are shown in the engraving of the model.

The peculiar shape of the vessel may also be gathered from this illustration. Data taken on the protracted two days' trials of the ship have been worked out. Thick weather prevented the section post on the measured mile from being seen, and speed was, therefore, taken by log. The results of the trials, indeed, are somewhat difficult to reconcile, and it would not, therefore, be wise, or perhaps fair to the builders, to put them on record. The practical result which has been arrived at seems to be that the speed with 8,000 horse power was nearly 15¼ knots. The speed with the three after engines working ahead was about 15½ knots, and the speed with all the engines running ahead was about 16¼ knots, the power in each case being at the maximum. The highest indicated power developed was 12,000, and this, we understand, corresponds with the speed of 16¼ knots. With the three after engines working ahead and the forward engine working astern the power was 11,250, of which the forward engine was never developing more than 2,000.

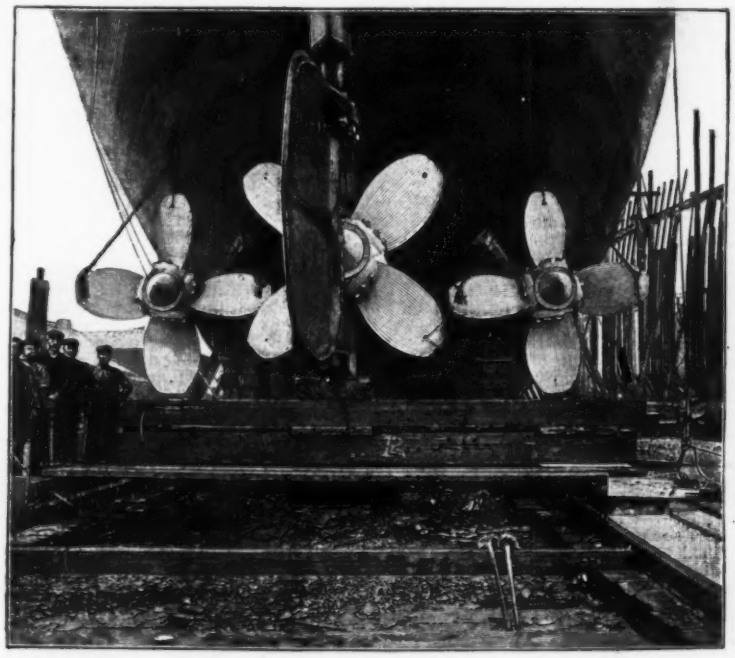
What is far more to the purpose is that the ship has made her first voyage most successfully. Admiral Makaroff first met the ice in the Baltic. It was drift ice, apparently about 5 feet thick, and, judging by the report of Mr. Gulston, of Newcastle, who accompanied Admiral Makaroff on his voyage, there seems to have been not the slightest difficulty in getting the "Ermak" through this obstruction, as she went comparatively easily at 9 knots, the engines working slowly. Before going into the ice the vessel had been slowed down to 10 knots, so as to reserve the powers of the engine room staff for the harder work which was to come.

The worst piece of ice which was encountered was estimated at 25 feet thick, and the ship went nearly through this formidable obstruction before she was

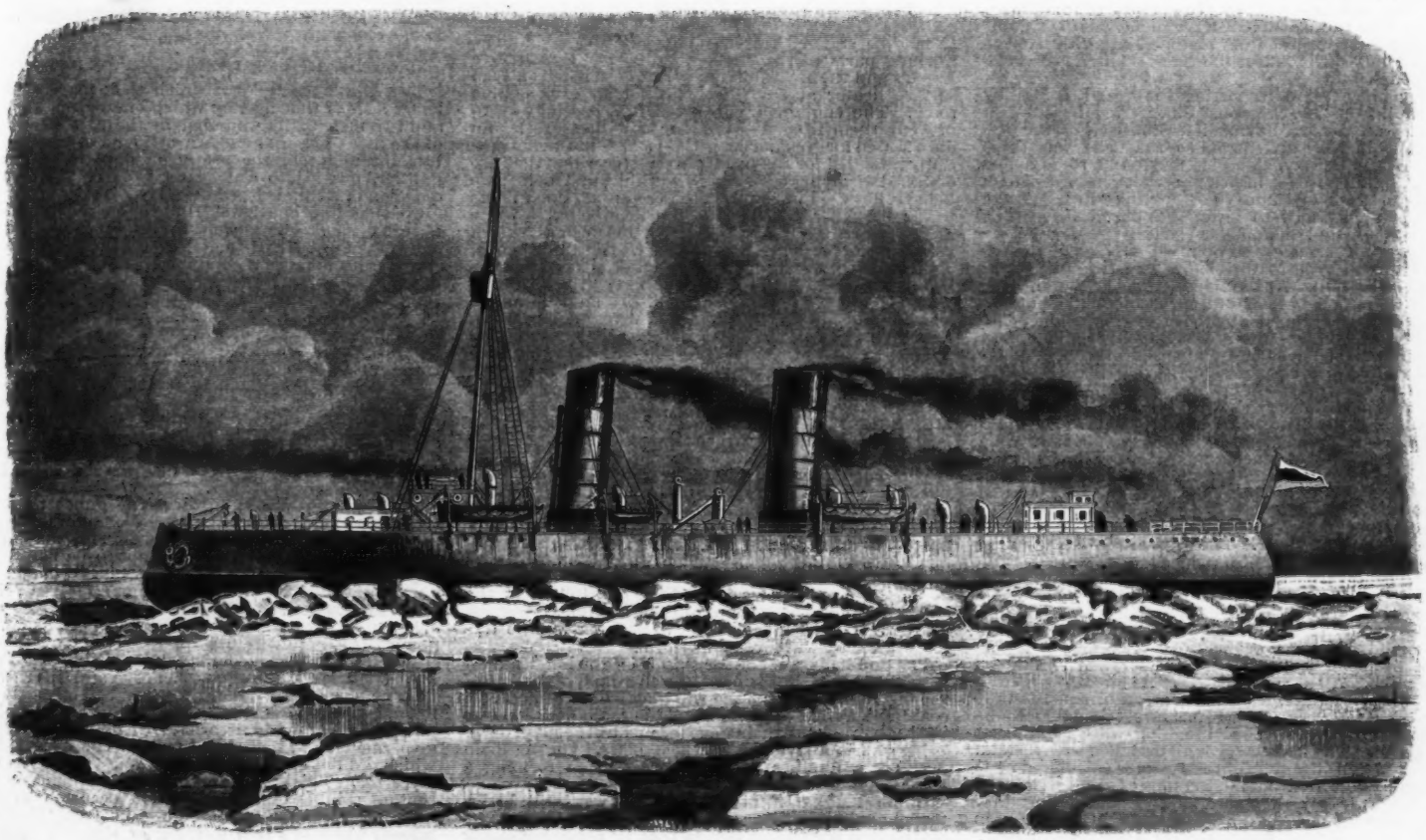
MODEL OF THE "ERMAK."



LAUNCH OF THE "ERMAK."



STERN OF THE "ERMAK," SHOWING THE THREE SCREWS.



THE ICE-BREAKING STEAMER "ERMAK" IN OPERATION.

brought up by it. Accurate measurements were taken as far as possible, and the report reads that the field ice was 5 feet in thickness, the pack on the top was 9 feet, and there was ice below the field amounting to 11 feet, so far as it could be measured, but may have been more, as there was no means of measuring a greater distance below the bottom of the field. It was evident that a large mass of ice had been washed off a shoal place and had frozen on to the field.

The worst field ice that they had much of was apparently 4 feet thick, with snow on the top of it. The snow seems to be the greatest impediment to the vessel's progress, as the designers of the ship had always been led to expect. Mr. Gulston reports that 12 inches of snow is a serious impediment, and 18 inches almost blocks her; this is, of course, on the top of thick field ice.

The ice generally in the Baltic appears to have been much more serious last winter than was expected, and it is said to be beyond 1883, which we gather was a record winter. The "Ermak" did not run continuously, but rested at night and started early in the morning, working with the searchlight. There was apparently no difficulty in starting, although the ship had become fast in the ice. Ice anchors were put out and the vessel was warped backward from her berth, after which she started apparently without any difficulty. One of the most satisfactory features is that she steers, as Mr. Gulston says, "in any way, at any time, in any ice." This has never been the case with any ice breakers that have previously been built, and is no doubt due largely to the form of the ship. As already stated, there is no flat place in her side either vertically or horizontally, so that unless absolutely frozen in solid she can be given some movement, and can thus be worked loose by her own propellers and by ice anchors laid out.

Her arrival at Cronstadt was evidently an extraordinary sight. The ice was about 18 inches thick, with a good deal of snow on the top, and the ship steamed through this at 6¼ knots up to the sea wall and past the battleships. She swung round on the port hand and entered the harbor through an entrance only 95 feet wide: the ship, it will be remembered, is 71 feet beam. She swung once in the inside harbor and one charge astern put her into her berth alongside the coal store. Some maneuvering trials were made in ice of about 2 feet to 3 feet in thickness, when the turning circle was found to be about 600 feet, and there was apparently very little difference in which direction the ship was turned. The effect of the bow propeller was most marked, and it seems practically to be that if the bow propeller is stopped, the ship stops too.

Mr. Gulston examined the ship both inside and outside as far as he could, and could find absolutely no sign of weakness. The outer skin is polished bright where the vessel has been running through the ice, but there are no signs of leakage anywhere. The ice varied enormously in quality. Drift ice was passed through and appeared to offer practically no impediment. Pieces described as being quite 2 to 3 acres in extent were apparently pushed aside, the ship moving through quite easily. Pack ice with 18 inches of snow on the top appears to have been the greatest difficulty. Field ice of about 18 inches to 2 feet seems to cause very little trouble, as the speeds of 7 and 8 knots seem to have been comparatively easily maintained. In places such as that in which the very thick ice described as of 25 feet in thickness was found—it consisting of very thick pack ice into which the ship had to charge—progress seems to have been not more than about 3 knots and sometimes even less. Considering that the voyage has been carried out under conditions which were absolutely strange, we feel that our readers will agree that the whole result is exceedingly gratifying to the designers of the vessel and all who have been connected with her construction. During the progress from Tolbeacon Light into the harbor the ship was accompanied by thousands of people in sledges, and the colonel of a regiment, who is a great friend of Admiral Makaroff, marched out with sixty of his men on "ski" to meet the vessel on arriving at the lighthouse.

Later information respecting the vessel comes by telegraph from Mr. Gulston. She arrived in Revel on Saturday afternoon, having left Cronstadt on the previous Wednesday afternoon, so that she was three days on the journey. The ice was found to be 20 feet thick, and nine frozen-in steamers were released. These vessels were convoyed out to sea by the "Ermak," and she was then about to bring into port others which were apparently lying outside the ice.

Each propeller has a set of main engines of the triple-expansion type for driving it when the full power has to be exerted. At the side of the shafting of each screw there is a pair of ordinary compound engines which drive the propeller by tooth gearing. The cylinders of the main engines are 25½ inch, 39½ inch, and 64 inch in diameter by 3 feet 6 inch stroke. These engines are of ordinary design, having high pressure piston valves with steam inside. The other valves are of double-ported flat type. All the working parts are of steel and the pistons are of cast steel. The crank-shafts are in two pieces 13¼ inches in diameter. The tunnel shaft is 12¾ inches in diameter, and the tail shaft 14½ inches in diameter. The boilers are double-ended, and six in number, 15 feet in diameter and 20 feet 6 inches long. There are two funnels 90 feet high and of 11 feet 6 inches outside diameter and 10 feet 6 inches inside diameter. The grate area is 800 square feet, while the heating surface is 27,600 square feet total. The propellers are all made with nickel steel blades containing 3 per cent. nickel, having a tensile strength of 40 tons; the stern propellers are 14 feet in diameter, the wing propellers being 14 feet 6 inches pitch, and the center propeller 14 feet pitch. The forward propeller is 13 feet in diameter and is 13 feet 6 inch pitch. All are four-bladed. As already stated in our previous article, the blades are enormously thick, and with the very strong steel are calculated to be brought up by ice without breaking when running at full speed. The machinery is all designed to withstand this test. The draught of the vessel is calculated at 19 feet in fresh water, having 300 tons of dead weight on board. This is the light draught which is designed for going into St. Petersburg. The draught of the ship working into the Kara Sea with 3,000 tons of dead-weight will be 25 feet. The total capacity of the ship to the upper deck is 14,783 tons; of this 3,900 tons may be taken as coal in the coal bunkers, and in the cargo spaces together if required. In the latter there is room for close on 113,000 cubic feet of cargo. The vessel is divided into 48 water-tight compartments, of which 14 are in the double bottom. There is one cross bunker for coal, as well as side bunkers. The fore and after peaks are arranged for trimming purposes, so as to bring the vessel by the head or stern with water ballast. There are also two heeling tanks amidships. There will also be amidships an anti-rolling tank. We are not aware whether this was fitted before the ship sailed, but arrangements had been made for its construction at the time of the trial; it was to hold 160 tons of water if needed. It is not desirable to fit bilge keels to ice-breaking steamers, and for this reason the anti-rolling tank is more necessary. Model experiment has shown that, with 40 tons of water, the amplitude of rolling can be reduced 7 per cent. on each roll.

The pumping arrangements for the ship are of an exceptionally complete description, and have been specially designed to suit the various compartments into which the vessel is formed. The pump room is a central compartment, perfectly water-tight, let into the middle of the vessel; being, in fact, a well, which descends to within 7 feet of the bottom. In the compartment thus formed there is on the main deck, and therefore 3 feet or 4 feet above the waterline, a donkey boiler, which is of the ordinary two-furnace return tube type. On the same deck, and in an adjoining compartment, is the electric light machinery, so that even if the main boilers of the ship were out of use, the electric light machinery could be run. The salvage pump has a capacity of 10 tons of water per minute, and it is situated in the well already referred to, so that if the ship were flooded above the level of this pump, the latter would be still accessible and capable of being worked. There is, in connection with this pump, a main drain running right from end to end of the ship as in war vessels; by means of this the fore and stern peaks can be made to interchange water, or the contents of either can be discharged overboard. There is a gage in the salvage well which shows exactly what the fore and aft trim of the ship is, the indication being obtained by means of pressure due to the head of water. The salvage pump is in communication with the different compartments of the vessel, so that, if necessary, any list due to the presence of water on one side of the ship can be corrected. There are also connections by which the draught of the ship can be altered by filling or emptying the ballast tanks. It is anticipated that this means of altering the trim of the ship will be of great use in working her through ice or for releasing her from field ice. There is also another function of the same nature performed by this ballast pump. It is arranged so that it can take hot water from the boilers and pump it into the fore peak, the hot water overflowing through valves in the bow and running down the outside of the skin-plating. Admiral Makaroff is of opinion that this will prevent rough ice adhering to the vessel. This ice might otherwise accumulate, the collection of smaller pieces in this way often being a most formidable obstacle to a ship's progress.

In addition to this salvage pump there are, of course, the usual feed, donkey pumps, etc., in various parts of the vessel. There are four centrifugal 12-inch circulating pumping engines, each of which may be made to connect to the main drain. There is a pair of Weir's pumps in each of the three engine rooms, and one large duplex auxiliary feed donkey in each engine room, as well as one duplex and bilge donkey in each engine room. There are also two ballast pumps placed in the ends of the vessel, besides several other small pumps.

Other machinery with which the vessel is fitted includes three evaporators for making up fresh water, each having a capacity of 25 tons, and there is also a separate fresh water distilling plant for drinking water. The boilers are pressed to 160 pounds to the square inch, and there are four 7-foot fans for forced draught. It may be stated that the main shafting and all the working parts of the engines are 35 per cent. above Lloyd's and the Board of Trade rules. There is a feed surface heater and a pressure filter in each engine room. The engines are jacketed in a special way to prevent them from freezing up; low pressure steam only is used for this purpose, the jackets not being specially intended for the usual purpose for which they are designed of giving economy in working, and being, we believe, not used in running. There are no brass liners to the propeller shafting, the bearings being in white metal, and there is a stuffing box between the stern post and the propeller boss on the Cedervall principle. This is fitted, because oil lubrication is used for the after bearing, and it is necessary to keep the lubricant which is pumped in from escaping. It may be added as a point of interest in connection with the discussion that took place last week at the Institution of Naval Architects that disconnecting the main engines from the line shafting and coupling up the auxiliary engines through their gearing occupied twenty minutes. The bolts in the collars of the shaft are withdrawn by an arrangement of gearing which operates all bolts at once—an arrangement which appeared to work excellently during the trial.

The machinery for this interesting vessel was supplied by the Wallsend and Slipway Engineering Company, having been designed under the superintendence of Mr. Andrew Laing, the general manager of the company. Great ingenuity has been shown in this department in solving the many difficult problems that were presented in the complicated arrangements of the machinery, not only on account of the multiplicity of the engines, but also on account of the exceptional strength that they should have in order to fit them for the trying work they will have to perform.

The double bottom of the ship is on the longitudinal system as usual, but is carried well round the turn of the bilge until it meets the wing coal bunkers. These coal bunkers are carried up to the main deck, widening as they ascend, their tops, formed by the main deck, being 27 feet above the flat keel plate. On the main deck are a number of cargo spaces, each forming a watertight compartment.

Admiral Makaroff, before the vessel was built, had a model made to scale, each compartment being represented by a watertight box, so that by removing one or more of these boxes he could find out what would be the effect of filling them with water. The center of gravity of each was found by experiment. If all compartments on one side of the ship were filled with water, she would heel to 70°, but had a margin of stability yet left, due to the central compartments. If, on the other hand, all the main compartments containing engines and boilers—and it will be seen that the machinery space runs from end to end of the ship—were filled, the vessel would be kept afloat by her wing passages and cargo spaces, and would have 6 inches of freeboard still left.

Reference should be made to the arrangement for coupling up this ship with another vessel or vessels in order to make a train of ships for more effectually dealing with thick ice. Although the "Ermak" is so big and strong a ship, there is, of course, a limit to her capacity of breaking up ice and to the speed with which she could perform the operation. A vessel pushing astern of her, therefore, would supply additional power for the work. Forward the stem is set at an angle of 70° from the vertical. In going through ice she would slide up, raising her bow, and this would cause the ice to break down. She might, of course, mount the ice until her forward propeller came in contact with it; but, as has been said, this is made of sufficient strength to withstand the shock. That, however, is not what is expected generally to occur, as the form of the bow is designed to keep breaking down the ice continuously. Of course, this would absorb an enormous amount of power; but if another vessel, either an ice breaker or an ordinary steamer, were pushing astern, naturally the speed could be increased. Moreover, a steamer not so strongly built as the "Ermak" would be protected by following close behind her. For this reason a recess has been built into the counter.

This recess is designed to take the stem of the following vessel, arrangements being made for lashing the latter in firm contact with the leading craft. There is a massive eyebolt at the stern, while the exceptionally strong bollards on each quarter would be used for attaching bridles, and the whole can be hove up by windlasses. It may be here mentioned that the "Ermak" has a special towing windlass aft, which was tested very thoroughly on the trials which we attended. There is another of the strong eyebolts or fair leads forward, as well as a special windlass, so that the "Ermak" might be coupled up to a sister ship arranged in the same way. Whether with such a powerful means of breaking through ice Admiral Makaroff will ever be able to reach the North Pole we will not venture to speculate; but certainly, if the feat is ever to be accomplished, it is brought far nearer by the advent of these ice-breaking steamers than it has ever been before. We cannot either say whether the admiral hopes to compass this crowning feat of exploration, almost the last left for man to accomplish, the ambition of navigators for centuries, and in the endeavor to accomplish which so many lives have been lost.

The ship has been built for the Russian government on the advice of the Minister of Finance, and under the inspection of a government commission, of which Vice-Admiral Makaroff was the president, other members being Capt. Ouspensky, Russian naval attaché in England; Capt. M. P. Vassiliev, of the Imperial Russian navy; Col. Poretchkin, of the engineering staff; and Capt. Petroff, also of the engineering staff of the imperial Russian navy. Mr. R. Saxton White, the general manager of the Walker Shipyard, and Mr. Andrew Laing, of the Wallsend Slipway, represented the contractors on the trial. The English government was represented by Mr. C. W. J. Bearblock, of the comptroller's department at the Admiralty, while Mr. Gravell watched the trials on behalf of the Bureau Veritas.

There are many interesting scientific appliances, chiefly the invention of Admiral Makaroff, on board the vessel. For the above interesting article we are indebted to London Engineering and for the engravings to Ueber Land und Meer.

THE SECRET HISTORY OF SMOKELESS POWDER.

By AN ENGLISH CORRESPONDENT.

THE disastrous accident which took place at Sandy Hook a short time ago, by which one officer was killed and two men badly wounded by the explosion of one of the finest pieces of modern artillery, and which was brought about by the use of an imperfect smokeless powder, has led to a good deal of comment on the question of smokeless powders.

Considerable light was thrown on the origin and nature of smokeless powder by a very interesting article written by Mr. Hiram Stevens Maxim, which appeared in the February number of The North American Review. Mr. Hudson Maxim has also written extensively on the smokeless powder question, calling attention to the part which he has played in the development of smokeless powder. The writings of the two Maxims will, therefore, give us a very fair outline of the early history and development of smokeless powder.

The French were the first to make and use a smokeless powder, and the first powder made by them was doubtless composed of collodion cotton dissolved in acetone and then dried and cut into grains. This powder, when exposed to a moderate temperature, gave off nitrous fumes, and very soon deteriorated so as to become absolutely worthless.

The next step was to dissolve true guncotton (tri-nitrocellulose) in acetone, then to evaporate out the acetone and granulate the residue. This made a stable compound, but it was found not to be suitable for anything except small firearms. This powder gave to a projectile about four calibers long an initial velocity of 600 meters per second, with a pressure of 3,000 atmospheres, or say a velocity of 2,000 feet per second, with about 20 tons pressure per square inch.

When it became generally known that the French had a smokeless powder, chemists and inventors in nearly all the countries of the world commenced experiments with a view of evolving a suitable smokeless powder to be used in firearms. Nobel, the great nitroglycerine maker, had already made a blasting gelatine which did not explode with the same violence as nitroglycerine. This compound had only about 5 or 6 per cent. of soluble guncotton, and it occurred to Nobel that if the quantity of soluble guncotton (di-nitrocellulose), which is a slow-burning or sluggish explosive, should be combined in large proportions with nitroglycerine, it would, to use his own expression, "tame"

the nitroglycerine and slow it up sufficiently so that it might be used as a "propellant" in guns. He made the experiment with about 40 per cent. of soluble guncotton. The result was "a hard and horn-like substance." He granulated this and found that it made a fairly good powder, producing still better results than those produced by the French powder.

Now it should be explained that there are two kinds of nitrated guncotton. Sometimes both kinds are called guncotton, but the term guncotton can only strictly be applied to the very highly nitrated cotton, which is chemically known as tri-nitrocellulose. This is a stable compound, will stand a great deal of exposure, and will not give off nitrous acid fumes at ordinary temperatures. The other kind is collodion cotton, which is chemically known as di-nitrocellulose. It is sometimes called soluble guncotton, because it can be dissolved in a mixture of equal parts of alcohol and ether. It is not a violent explosive, but is rather slow burning; in fact, in the British Explosive Act it is not considered an explosive at all. Unlike tri-nitrocellulose, it is not a stable compound, but is liable to spontaneous decomposition at comparatively low temperatures. It, however, makes a very hard compound when combined with nitroglycerine, and can be mixed with it with much greater facility than true guncotton. True guncotton is almost as explosive as nitroglycerine itself.

Nobel, Hiram Stevens Maxim, Sir Frederick Abel, and Prof. Dewar were all working at the same time on the same problem, but while Nobel was working on di-nitrocellulose, Hiram Maxim sought to employ the more stable compound, tri-nitrocellulose, and he was the first to make a powder composed of nitroglycerine and true guncotton. Sir Frederick Abel has always been looked upon as one of the greatest authorities on high explosives. All the true guncotton used in the world to-day is made upon his formula, while Prof. Dewar is not only a great chemist, but a most careful experimenter. These two gentlemen were working together, and as both of them knew of the unstable character of the di-nitrocellulose employed by Nobel, they sought to use tri-nitrocellulose in its place. Now it so happened that both Hiram Stevens Maxim and Messrs. Abel and Dewar thought that some third element was necessary in order to prevent detonation. Mr. Hiram Maxim had already experimented extensively in black powders and other explosive compounds in which vaseline, paraffine wax, and castor oil were employed, and it was found by him that any thick or viscid grease would prevent detonation in almost any explosive mixture, and, after very careful and extensive experiments, he finally decided to employ castor oil, and in his patent he claims "a compound of nitroglycerine, guncotton, and castor oil, or other suitable oil," which was to be used for the purpose of preventing detonation. In the Abel-Dewar powder the grease employed was in reality a thick cylinder oil or vaseline, referred to sometimes as mineral jelly and at others as a hydrocarbon. Abel and Dewar's patent was taken only fourteen days after Hiram Maxim's. It will, therefore, be seen that they were working quite independently of Maxim and that in their experiments they selected an oil which, in all its physical characteristics, very closely resembles castor oil. In their patent they claimed a mixture of nitroglycerine, guncotton, and a hydrocarbon called mineral jelly.

The Abel-Dewar powder gave muzzle velocities of 2,000 feet with a pressure of 16 tons to the square inch, or 4 tons less than the French powder. Maxim's powder did the same thing; in fact, in some cases a muzzle velocity of 1,975 feet was obtained with a pressure of only 12 tons per square inch. Messr. Abel and Dewar were employed by the British government to develop a smokeless powder, and their powder was taken up by the government, whereupon Nobel claimed that his patent had been infringed. But the courts decided that a mixture of nitroglycerine and collodion cotton, which was a sluggish explosive, was quite different from one in which two violent explosives, like nitroglycerine and true guncotton, were employed, and where grease was employed to prevent detonation. The court therefore decided that Nobel's patent had not been infringed, and this was borne out by the Appeal Court and also by the House of Lords.

It was believed by many at the time that the government, in order to beat Nobel, had to admit that they were infringing Mr. Hiram Stevens Maxim's patent. Suit was accordingly brought by Mr. Hiram Maxim against the government, and the courts decided that Mr. Maxim's patent had not been infringed, because vaseline was not an oil, but a hydrocarbon, notwithstanding that the trade name of the material was "cylinder oil." It was also claimed that, as more than 50 per cent. of Maxim's powder was guncotton and less than 50 per cent. of guncotton was employed in the government powder, the government powder was essentially a nitroglycerine powder, while Maxim's powder was essentially a guncotton powder; therefore, the patent had not been infringed. This decision led to a great deal of ridicule in the newspapers, and it was said at the time that it was quite fruitless for one to sue the government for infringement of a patent. In the Nobel case, however, Sir Richard Webster, who appeared for the government, said that Nobel's powder was not a nitroglycerine and guncotton powder, but a nitroglycerine and collodion cotton powder, and that Mr. Hiram Stevens Maxim was the first man in the world to make a smokeless powder in which two violent explosives were employed, namely, nitroglycerine and true guncotton. The validity of the Maxim patent was not called into question. It was admitted to be valid by the government. They only claimed that they had not infringed it.

Hiram Stevens Maxim's experiments extended over many months and appear to have been conducted with a great deal of care. Experiments were conducted not only to find out what compounds, what size of grains, or what shape of powder produced the best ballistic results, but experiments were also made with a view of ascertaining the safety and keeping qualities of the powder. It was found that when a large percentage of nitroglycerine was employed, as in the government powder, it would sweat out, and when loaded into cartridge cases would sometimes cover the inside of the case with a dew of nitroglycerine. Mr. Hiram Maxim contended stoutly at the trial that the government were using altogether too much nitroglycerine for safety. Subsequently to this the government made an experiment to prove that their powder could not be detonated. A large quantity, perhaps a ton or so, was piled up on the ground and ignited. It burned for a short time and then detonated exactly like dynamite. It is evident that sufficient nitroglycerine did sweat out and appear on the surface, and acted as a kind of fulminating cap to the whole mass. Sir Andrew Nobel conducted a series of experiments and reported that British cordite containing 60 per cent. of nitroglycerine would not detonate. Mr. Hiram Maxim, on the other hand, claimed that the nitroglycerine would sweat out and that cordite would detonate, and by an apparatus by which a circulation of warm air was maintained through cordite, he succeeded in collecting a considerable quantity of pure nitroglycerine in a bottle from British government cordite. He also made other experiments, and, by using a large detonating cap, found that not only the British government cordite, but any form of smokeless powder could be detonated exactly like dynamite, provided a sufficiently large detonating cap were employed.

At the time that Mr. Hiram S. Maxim commenced his experiments there was a very strong feeling against the use of nitroglycerine in any form in smokeless powder. He therefore first sought to make a powder from pure guncotton. He dissolved his guncotton with acetone, formed it into thick paste, spread this paste upon large sheets of glass in a sealed chamber, and then passed a current of warm air over the surface, the air passing through a condenser. In this way he recovered about fourteen-fifteenths of the acetone used as a solvent. The dried sheets were then cut into squares, polished and loaded into cartridges. The first experiments were quite successful. The powder produced identical results with the French powder; in fact, the powder itself was identical with the French, but when the powder had been kept for some time, it became opaque and semi-fibrous. It was then found to burn with great violence and to produce high and dangerous pressures. Investigation showed that when the good results had been obtained there was still present in the compound about one per cent. of acetone, and that on the disappearance of the last trace of acetone the powder became violent. The next step was to combine about two per cent. of castor oil. The castor oil, of course, would not evaporate but would remain as a component part of the powder. In this way the keeping qualities of the powder were rendered excellent, and powder which was made eight years ago is found to-day to be quite as good as new, producing the same results that it did at that time.

As castor oil had acted so well on pure guncotton, experiments were made with nitroglycerine, and it was found that with 2 per cent. of castor oil present, any compound between 1 per cent. and 80 per cent. of nitroglycerine might be employed, but when a large percentage of nitroglycerine was employed it was necessary to use the powder when freshly made, otherwise the nitroglycerine evaporated, or if it were loaded into cases, it would condense on the inside of the case and act like so much fulminating powder.

The first smokeless powder to make its appearance in Russia was made by Hiram S. Maxim, in England, and contained 73 per cent. of guncotton, 25 per cent. of nitroglycerine, 2 per cent. of castor oil.

This made a very hard compound closely resembling celluloid, but as experiments went on and as the prejudice against nitroglycerine was still very great, the quantity of nitroglycerine was ultimately reduced to about 13 per cent., and it was a powder of this kind that was sent to the United States of America by Mr. Hiram S. Maxim about eight years ago, and tested at Springfield in competition with two forms of French powder, two forms of English powder, one of Belgian, and several of American. At these trials, according to the official printed reports made at the time, it was found that the Maxim cordite was superior to all the other powders at all points.

The powder patented by Mr. Hudson Maxim and Dr. Schupphaus substituted urea for castor oil, and, in order to produce great hardness, Dr. Schupphaus also used a considerable quantity of collodion cotton. To improve the burning qualities, Dr. Schupphaus squirted or spun the powder with a large number of minute longitudinal perforations extending completely through the sticks. It was believed that these perforations would cause the powder to burn from the inside as well as the outside and would practically keep the burning surface the same until the charge was completely consumed. It is true that tubular powder which burned from the inside as well as from the outside had already been made by Mr. Hiram S. Maxim, who had supplied a quantity of it to the French government, which produced excellent results. Quite extensive experiments have been conducted in England with multiple perforations, and these experiments have shown that whenever the pressure rises to 14 tons or more, the burning of such powder is very erratic. It appears that the fire or flame enters these fine perforations, where it sets up a high pressure, higher indeed than the pressure in the chamber itself. This pressure is liable to blow the powder into fine atoms, that is, the grains of powder go off with great violence something after the manner of popping corn, an explosion within an explosion.

An interesting account by Mr. Hudson Maxim of this explosive action, as it probably occurred in the bursting of a 10-inch gun at Sandy Hook, will be found in the SCIENTIFIC AMERICAN for April 8, 1899. The writer states it as his opinion that the fault of the powder is one of form; and that the perforations are too long and encourage a rise of pressure in the escaping gases. He proposes to remedy this by using transverse perforations which would allow the gases to escape freely as they were formed in the interior of the sticks of powder.

SANITARY PAINTING.*

A TRULY ancient and honorable handicraft is that of the painter; one of the few that have come down to us from the remotest antiquity practically untouched by that all-devouring ogre which has destroyed so much handicraft—I mean machine production.

In painting you still get the personal equation which no machinery can ever substitute. In all art work it is the personal equation that confers the merit upon the work. This is, of course, well recognized when fine art work (as it is called) is under consideration. But house painting is so familiar that it incurs the contempt of those who, from lack of training, are unable to appreciate either its æsthetic value or the degree of personal skill displayed.

And yet, to the ready observant, how interesting is a bit of properly executed painter's work. To appreciate the æsthetic value of the different textures of the surface, as finished by the skillful painter, and to realize the manipulative skill and feeling for effect that went to produce them, is an education in itself. Then the general practical knowledge of color required to be brought to bear in the harmonious tinting of structural work can only be fully appreciated by those who have tried. In fact, to the house painter as much as to the fine art man, is it necessary to bear in mind that his paints must be mixed with brains. And then, what scope there is for the exercise of skill and knowledge in the mere mixing and alternating of the coatings of paint in order to obtain from it the greatest protective power. From the merely protective point of view, unskillful painting may mean monetary loss through rot and weather influences which the paint has failed to keep out, while skillfully painted work always means money saved.

I think, therefore, a few words designed to disseminate a truer conception of the sanitary, æsthetic, and protective value of good painters' work may not be without interest in an important city like Liverpool.

In his way the sanitary painter is even more important than the sanitary plumber. The plumber's sanitary appliances are located in a few well defined places in a building, and the application of his skill is limited accordingly, whereas the painter's sanitary work extends from cellar to garret, and almost embraces every yard of the interior surface of the building.

When it is realized that one-third of our lives is passed in our bedrooms alone, and probably half or more indoors, how important does it become to have our dwellings sanitary in the highest degree; and for this sanitation the public must depend mainly upon the painter. He it is who must remove all old colorings and all old papers, which are necessarily tainted with the effete exhalations of the occupants, and these are known to be poisonous; fill up all crevices which harbor disease germs; rub down old paint to smoothness, and fill up its dents and cracks so that it shall not easily catch and retain unsanitary germs; in fact, do all those things which in specifications are commonly classed under the word "prepare." Now, as the preparing of work is not to the untutored eye self-evident in the finished result, this part of the work is frequently omitted or scamped, and, indeed, this omission or scamping always takes place in low-priced work; and this fact principally accounts for the extraordinary variations of price in painters' work.

If the public only realized what whited sepulchers they go into in the shape of rented dwellings, offices, shops, and the like, in which this elementary sanitary work has been grossly neglected, they would insist upon every master house painter being registered or licensed like any doctor, lawyer, or other professional man whose work is of such general public importance as to require a public certificate of competency to entitle him to practice.

To many this may seem far fetched, but to those who keep abreast of the science of the day and appreciate the bearing of the results of modern bacteriology, I feel sure these remarks will appeal with full force.

In the public interest I cannot too strongly emphasize this point; it is one which touches the public health very closely, and in its own interest the public should demand from those who practice the art of domestic painting the most conscientious performance of their sanitary work.

In this connection let me say that the modern system of competitive tendering for sanitary work of any kind is simply a premium on scamping. It is no uncommon thing for painting tenders to vary 100 per cent. for what purports to be identical work, and the public generally, failing to recognize any other measure of value than that of price, accepts the lowest tender. But can any one, knowing human nature, reasonably expect the conscientious performance of work under such conditions?

There are no worse offenders against common sense in this respect than committees and public bodies. They allow the idea that as custodians of the money of their constituents they are bound to exercise the most rigid economy to dominate every consideration, and altogether overlook the fact that scamped work of this class is really, when broadly and fully considered, the least economical for the public, whose interests they are trying to serve.

It seems to me that if those who obtain competitive tenders made it a rule to accept the tender nearest in price to an average of all the tenders received, much better results would accrue and a truer economy be observed.

Not less important in its bearing upon the comfort and happiness of the public is the house painter's work from the æsthetic side.

The important effect of environment upon animals generally, and upon man in particular, is well recognized by scientists like Darwin, Wallace, and others; and, although their works deal mostly with the effects of climatic and geographical environment, the principles they have laid down are well recognized as applying to social and æsthetic environment.

Each one from his own experience knows that some kinds of coloring confer pleasure, while others leave him unaffected, or even go so far as to give pain and produce physical and mental discomfort.

Now, quality in color is one of those things that cannot be described in a specification. It can only be felt by those who have the color sense and interpreted by those who have an additional technical skill. It is not a thing you can schedule at so much a yard. It can only be obtained from certain individuals who have been endowed by nature and who must have a free hand to produce their best effects.

Far reaching and subtile are the influences of æsthetic color in the domestic and business environment of our daily life. From the home where the tiny impressionable children spend so many hours and where good and bad æsthetic impressions become firmly fixed on young and sensitive organizations, through school

* An address delivered at the convention of the Master House Painters of England and Wales, by Mr. A. G. White, president.

and business life, from the cottage to the palace, in all our surroundings we are soothed, stimulated, calmed, and invigorated, or the reverse of all these things, according to the kind of color impressions we surround ourselves with. Is not the benefit derived from going to the country or the seaside, or from foreign travel, as much due to the color impressions we receive as the fresh air we breathe or the change of climate?

In short, so subtile and yet so persistent in its effect upon the human organism is the quality of color that it is a surprising thing to those who, like house painters, make the study of color the business of their lives, to find so little real appreciation of its value among the general public. And yet, rightly appreciated, the consideration of these things forces us to the conclusion that the color work of the house painter is only a wider form of his other sanitary work, affecting as it does so intimately the health of his clients. In a word, the house painter is really a kind of color doctor, who ought to be able to prescribe intelligently in terms of color, and to whom the public should turn for color advice, instead of being, as at present, much given to inconsiderately swallowing any quackery in the way of color which may happen to be the rage of the moment.

To see the devotion and determination of the victims one would think that their eternal salvation in a color sense depended upon their living in an environment of ivory-white and a Morris paper, as though, like a certain notorious medicine, these were a "safe cure" for all the color ills that flesh is heir to.

There is one side of painting that I think the public do really appreciate the value of to some extent, viz., its protective value. In fact, they go to the extreme frequently, and think that in a multitude of coats of paint there is safety. At all events, many specifications, especially those emanating from architects' offices, are largely over-specified, to the great delight of the cut-price tenderer, who sees his opportunity to hoodwink the architect and the public by posing as the cheapest of the cheap, when he is only the most unscrupulous of his tribe and never intends to carry out the requirements of the specification.

In the matter of the protective value of paint there is as much danger in too many and too thick coats of paint as in too few and too thin. Nor is it merely upon the number of coats of paint that the protection depends. The nature of the texture of the surface, its chemical qualities, the nature of its environment, whether exposed to excessive heat or cold, or wet, or wind, and sand, or chemical fumes—all these things have to be considered when the protective value of painting is in question.

The time of the year when the painting is done modifies the practice profoundly, and the materials which in summer give excellent results, in winter would fail entirely.

These considerations bring us back to the point we started from, viz., preparation of painters' work; for if preparation is essential from the sanitary point of view, it is doubly so from the point of view of durability. The time spent on the preparation of old work before any paint is applied, and the subsequent between-coat preparation, is of the highest possible value as bearing in the most direct manner upon the ultimate durability and therefore protecting power of the paint.

Here let me say that the public seem to fail entirely to appreciate the value of drying time as affecting the appearance and durability of painters' work. Nowadays a painter is almost afraid to ask a reasonable time for the execution of his work. The client is so accustomed to seeing business work carried on around him in the shortest possible time, that he expects the same thing from the painter, and often gets it, but to his own detriment. The public ought to realize that the processes of painting are practically the same today as they were in the remote past; that machinery and labor organized to work to high pressure cannot effect in the painters' work what it can in the other trades, because painting is a handicraft, and because time is an absolute necessity between the processes if the work is to give satisfaction.

Scamped preparation means frequent repaintings and frequent expense.

The life and health of a building, therefore, depend upon its intelligent protection by paint.

So that whether you consider the house painter from the point of view of the preparation of the interior of a dwelling or from the color treatment of the dwelling, or from that of the protection of the exterior of the dwelling, he is, and ought to be, in all his work a sanitary expert in the highest and broadest sense of the word and enjoy a high degree of consideration from the public accordingly.

I have endeavored thus briefly, and avoiding technicalities, to put into popular form some of the broad facts that underlie the practice of the painter's art, in the hope that the public may more adequately appreciate how important it is that a class of work bearing so directly upon the public health and happiness, both physical and mental, should be intrusted to really competent exponents of the painter's art, and that it may realize the good old English maxim that the "best is the cheapest," applies in the highest sense of the word to the art of domestic painting.

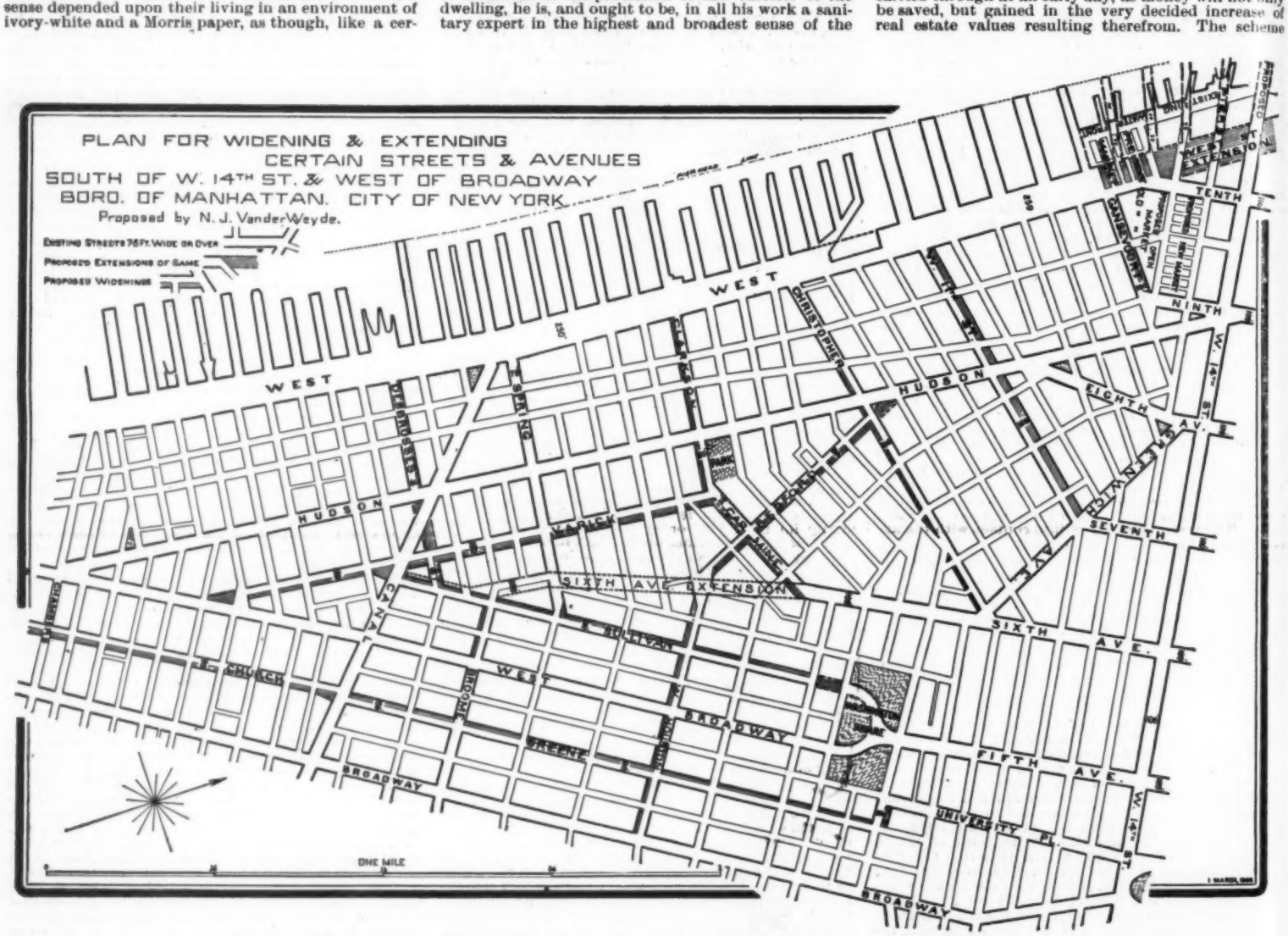
In his paper recently read before the Society of Arts, Mr. J. H. Collins stated that mining in Cornwall has been carried on for more than 3,000, if not for more than 4,000 years, and that the tin required for fixing the colors of the scarlet curtains of the Hebrew Tabernacle, and in making the brass for Solomon's Temple, as well as that used for the bronze weapons of Homer's heroes, was pretty well certain to have been derived from the gravels of our West Country valleys. Having given the subject much consideration, Mr. Collins does not see how anyone could reasonably doubt that the conclusions set forth many years ago by Dr. Barham, afterward by Sir Henry James, and also by Dr. George Smith in his most interesting book called the "Cassiterides," and by the late Mr. R. N. Worth, in his "Antiquity of Mining in the West of England," were substantially correct; and that the Phenicians traded for tin in the West of England with the inhabitants of a group of supposed islands long before Solomon's Temple was built.

PROPOSED WIDENING OF NEW YORK STREETS.

By N. J. VANDER WEYDE, Civil Engineer.

IN the accompanying map we desire to call the reader's attention to New York's magnificent water-front boulevard, 250 feet wide, which when completed will extend along the east bank of the Hudson River from Battery Park to West Sixty-first Street, a distance of five miles, furnishing facilities for the shipping trade unequaled in any other seaport of the world. The lower ends of half a dozen 100 foot wide avenues are indicated; they lead from the upper end of Manhattan Borough, but have no adequate outlet to either the water-front street above mentioned or the lower and wholesale business portion of the city. A conglomeration of narrow streets and alleys in what was once known as Greenwich Village blocks the way to the heavy truck and the rapid delivery wagon.

The Church Street widening has been talked about since long before the civil war, and should have been carried through in those days. The recently proposed Sixth Avenue extension has reopened the question at this time, and although desirable enough by itself may be found to be superfluous should Mr. Vander Weyde's comprehensive scheme, illustrated here, be adopted. This much needed opening up of this section should be carried through at an early day, as money will not only be saved, but gained in the very decided increase of real estate values resulting therefrom. The scheme



MAP SHOWING PROPOSED STREET WIDENING IMPROVEMENTS, NEW YORK CITY.

looks like an extravagant enterprise, and the more timid may suggest that only certain features of it should be carried out at present; but business enterprise is being retarded in this district, and is reaching out elsewhere, ultimately to leave old Greenwich Village, with its village streets, to its village trade forever.

In this plan the central idea is to open up the various sections of the city which now seem dead to business enterprise.

University Place, Fifth, Sixth, Seventh, Eighth, and Ninth Avenues, which give such fine facilities for uptown travel, have no adequate outlet to that business portion of the city known as the wholesale dry goods district and to the North River water front. By widening Gansevoort one block, lower Ninth Avenue obtains better connection with the river front; the widening of West Eleventh Street helps both Seventh and Eighth Avenues; while Carmine and Clarkson seem to afford the best relief for Sixth Avenue in that direction, and Varick Street gives relief toward Canal Street; the extension and widening at Desbrosses is also necessary to adequately carry out this scheme.

Desirable but not so necessary is the widening of Christopher, Bedford, West Houston and Broome Streets; but Sullivan and Greene should certainly be widened, the latter connecting with the long contemplated widening of Church Street north of Fulton. Such a plan creates alternate wide north and south streets from Elm Street, recently widened (east of Broadway), to Sixth Avenue and its proposed extension; with Crosby, Mercer, Wooster, Thompson, and Macdougal Streets in between, which though narrow are desirable adjuncts to the packing and shipping departments of large business houses located in the wider streets.

This plan can be carried out either in conjunction with or without the proposed Sixth Avenue extension. The greater advantage of utilizing existing streets by widening them in preference to cutting diagonally through everything and leaving cater-cornered blocks here and there should not be lost sight of.

A PORTABLE GASOLINE ENGINE.

IN agricultural matters, as in all the industries, progress necessitates mechanism. It alone permits of diminishing the cost of production, and it, for the most part, has made American agriculture what it is at the present time. Machines have, to be sure, been introduced into Europe; but, in France especially, this has been done only with some timidity—a fact that will be understood when we come to reflect that the motor required has hitherto been the steam engine.

While recognizing the valuable advantages of this, we cannot help remarking that the management of it is quite a delicate matter. It cannot be intrusted to the care of one person or another at random without having it run under very poor conditions, and even at the risk of explosion. It has the drawback, too, of being heavy, while in agriculture the motor should be capable of being easily moved about. Finally, it is costly, and, in some regions, the fuel to supply it is high priced owing to freight charges.

The substitution of a gasoline for a steam motor remedies all such inconveniences. This is a fact so patent that we have no need to dwell upon it, and one that is so fully recognized in England, even, where coal is abundant, that not a single agricultural competition takes place in which there is not exhibited a large number of portable gasoline engines. This is why we desire to call attention to such motors, in taking as a type an engine built by the Tangyes establishment, at Birmingham.

In this apparatus everything is so arranged as to assure lightness and strength, since the engine often has to be drawn over bad roads. The wheels are wholly of iron, with a wrought iron axle. The fore carriage is provided with a king bolt connecting it with the frame. The latter, which also is of iron, forms a water reservoir. The question of water is an important one when it became necessary to work often in an open field where it is impossible to renew the supply. The cooling of the water in the apparatus under consideration is assured in quite an original manner. A small rotary pump, fixed laterally to the motor, properly so called, is actuated by a pulley keyed upon the crank shaft, and sucks water into the reservoir which we just mentioned. This water is sent into the cylinder jacket, and afterward passes into a pipe that starts from the top of the cylinder and is connected with another conduit which is arranged in a sort of hood that surmounts the roof of the engine. The vertical water pipe is plainly seen to the right in the accompanying figure.

The water forced to the top of the roof makes its exit from the upper conduit through a multitude of small apertures and is projected against the sides of the hood, which likewise are provided with a number of apertures. The water thus comes into contact with the atmosphere and is rapidly cooled.

The water, as it falls, collects upon the roof, and thence naturally descends into the reservoir, which holds a supply sufficient for one day's work.

The lamps designed to heat the vaporizer and the ignition tube are inclosed in a large box which protects them from the gusts of wind that are so frequent in the open field. The burners receive the gasoline from a reservoir provided with a small pump that assures a certain pressure upon the hydrocarburet and that needs to be set in operation only a few times during the day.

It is unnecessary for us to dwell upon the subsidiary arrangements, which are the same as those ordinarily found in a gasoline motor, and we shall merely mention the safety device placed above the crank shaft in the apparatus under consideration.

With this engine, which is designed to give 6 horse power at the brake during regular work, and which is tested for a power 25 per cent. greater, it is possible to

THE TANGYES PORTABLE GASOLINE ENGINE.

introduce motive power upon a farm cheaply and without any danger.

For the above particulars and the illustration we are indebted to La Nature.

A LARGE SNOUT BORING MACHINE.

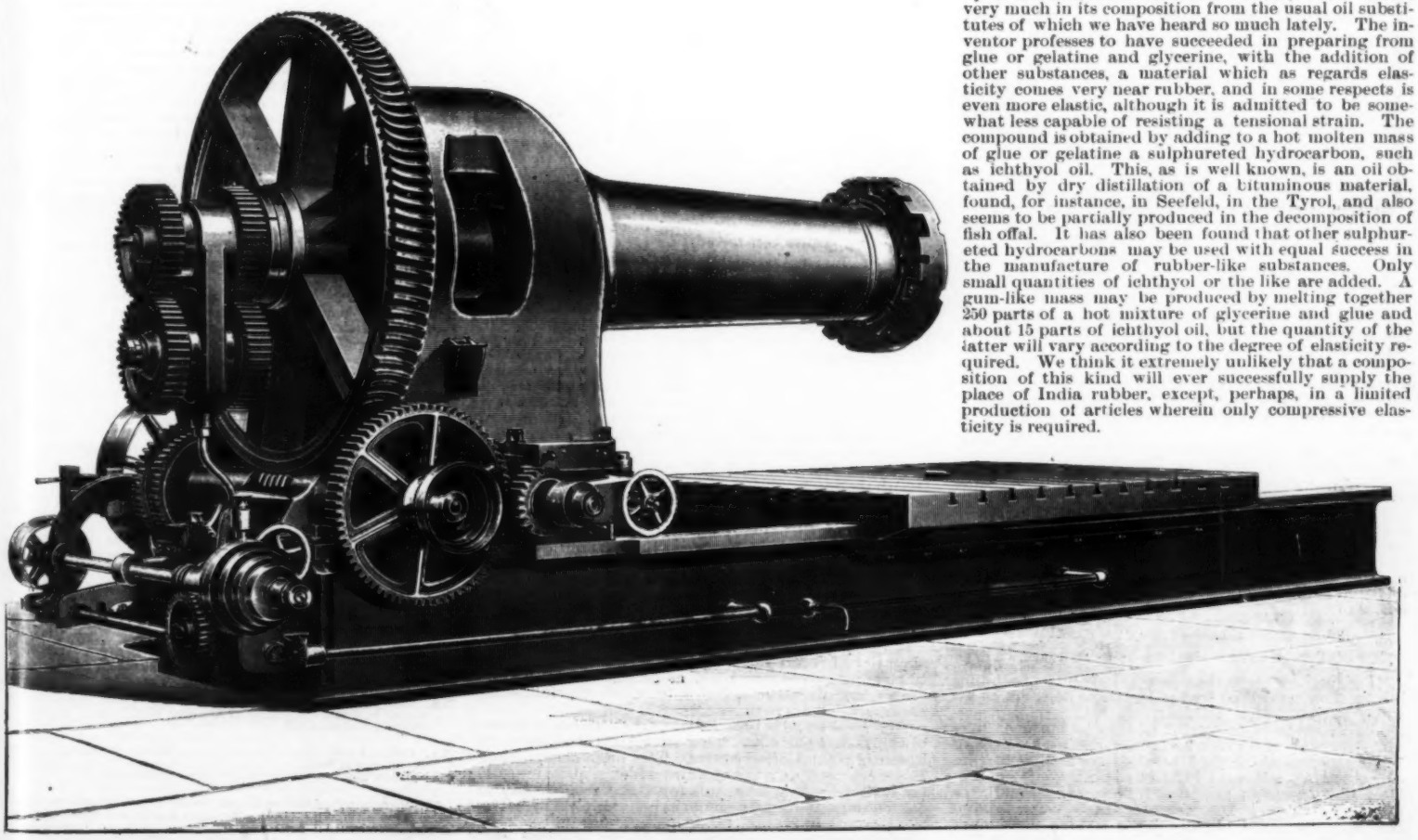
A VALUABLE but uncommon type of machine tool is the snout boring machine, a very fine example of which is illustrated herewith. This particular example is of special interest, because, in the first place, it is the latest and largest that Messrs. Joshua Buckton & Company, Limited, have made, and secondly, because it is designed to be driven by an independent electric motor.

The origin of the distinctive name is evident, the prominent feature of the machine being the long, strong snout which projects into the cylinder to be bored and supports the boring head. The tool illustrated is primarily intended for boring and facing cylinders and liners for marine engines up to 6 feet in diameter by 6 feet long, but is, of course, also suitable for a variety of other work, such as boring gun hoops, for example, and has the advantage that it is possible to bore up to a dead end, as, for instance, a cylinder with the end cast in solid, without any boring bar or stay being required. The engraving shows the tool in order for boring.

It will be seen that the cutter head is carried on the end of a spindle which passes through the massive snout, and has keyed on its back end the big worm wheel by which it is rotated. The work fixed upon the table, which is 8 feet square, moves forward to give the feed. The spindle is 15 inches diameter, with a conical neck running to 18 inches diameter at the end of the snout, and has a long bearing, so that, both on account of its size and the surface, any slackness is out of the question, but, furthermore, the conical part is lapped into its place to obviate the remotest chance of shake. The diameter of the snout itself is 26 inches. Taking these various points into consideration, it will be seen that the accuracy of boring in this type of machine is likely to be far greater than in those of the usual pattern. We do not wish to convey the idea that there is no deflection. That is impossible, but the deflection is in the first place exceedingly small, and in the second place is a constant quantity; so that, except for the decrease in diameter due to the wear of the tool, the hole bored must be parallel and entirely free from the bellying which results when boring with a machine in which the distance of the cutting tool from the points of support is continually changing.

The manner of driving this spindle will be understood from the accompanying engraving. The motor shaft crosses the machine diagonally, carrying on its end a skew pinion which drives a wheel immediately above it. This wheel is keyed to a shaft which crosses the machine, and carries at each end two wheels on sleeves. All four wheels are of different diameters. Parallel to this countershaft there is a second shaft with a large worm keyed to its central part. It runs in long gun-metal bearings, and on either side of the worm there are a set of steel and gun-metal anti-friction plates. To each end of the shaft are keyed two wheels. All four are of different diameters, and each one can be made to engage with one of those on the countershaft by moving the latter by means of the screws and hand wheels. Thus there are four changes of cutting speed. The motor runs at 1,500 revolutions per minute and the countershaft at 125. It is worth observation, in passing, that there is no lost motion in this system of driving, as the transmission is positive throughout, no belts being used. It will be noticed that on the end of the main worm shaft there is a four-step cone pulley, and on another shaft parallel to it a similar cone. This is the feed mechanism. By a simple and ingenious arrangement eight rates of feed are obtainable by it. The second shaft is driven from the main worm shaft. Inside the large part of the former is an internal ring of gear, engaging into a pinion running on a stud fixed in the face of a plate, the edge of which can just be seen. There is, it will be observed, a small clutch on the outer end of the cone, and vertically above the plate is a catch. When this catch engages in a notch in the plate, and so prevents it rotating, the clutch being in gear, the speed is reduced one half, as the transmission takes place through the pinion to a wheel on the spindle one-half the diameter of the internal gear. There are four changes through the cones alone. On the shaft thus driven there is keyed a worm engaging with a wheel which is visible; on the shaft carrying this worm wheel is a second worm driving another worm wheel on a second spindle, which carries a bevel pinion driving the bevel wheel, the upper part of which can be seen, keyed to the screw which feeds the table. It will be observed that on the other end of the main worm shaft is a large drum which drives by means of belts a pair of fast and loose pulleys on the first feed shaft. This is for moving the table rapidly. The belts are thrown in and out in the usual manner by rotating the shaft running beside the bed of the machine.—The Engineer.

A patent has recently been secured in this country, by a German, for an artificial rubber, which differs very much in its composition from the usual oil substitutes of which we have heard so much lately. The inventor professes to have succeeded in preparing from glue or gelatine and glycerine, with the addition of other substances, a material which as regards elasticity comes very near rubber, and in some respects is even more elastic, although it is admitted to be somewhat less capable of resisting a tensional strain. The compound is obtained by adding to a hot molten mass of glue or gelatine a sulphureted hydrocarbon, such as ichthyol oil. This, as is well known, is an oil obtained by dry distillation of a bituminous material, found, for instance, in Seefeld, in the Tyrol, and also seems to be partially produced in the decomposition of fish offal. It has also been found that other sulphureted hydrocarbons may be used with equal success in the manufacture of rubber-like substances. Only small quantities of ichthyol or the like are added. A gum-like mass may be produced by melting together 250 parts of a hot mixture of glycerine and glue and about 15 parts of ichthyol oil, but the quantity of the latter will vary according to the degree of elasticity required. We think it extremely unlikely that a composition of this kind will ever successfully supply the place of India rubber, except, perhaps, in a limited production of articles wherein only compressive elasticity is required.



SNOUT BORING MACHINE.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Obstacles to Exporting Machines to Germany.—This consulate is frequently called upon to assist in the adjustment of annoying controversies between American manufacturers of machinery and tools and their German customers, arising from damage to goods in transit, delays in shipments, and vague contracts, says United States Consul G. P. Pettit, of Düsseldorf, Germany. These difficulties, unless guarded against more carefully, will become very serious obstacles to the progress of this important and rapidly increasing item of American trade in Germany. Damage to machinery and machine tools in transit has been very frequent, and I have just seen one shipment in which three very valuable machine tools were completely ruined, the cast-iron frames being broken in several places. It is impossible to ascertain whether the damage was done by the railways in America, the steamship companies, or by the railways in Germany. Nobody seems to be responsible. It is alleged, however, by those interested that these heavy machines are subjected to very rough handling by the steamship companies. It is said that they jerk them out of the vessels with steam cranes, often hooking to frail castings which are not strong enough to sustain the weight. Before accepting damaged machines, the German buyer examines them while in the possession of the railway at the final destination, and they are also exhibited to witnesses before being taken from the depots, resulting in protested drafts, long and disagreeable disputes, and sometimes expensive lawsuits. Delay in the delivery of machines has also in several instances resulted in heavy losses. In one case, an apparatus valued at over $3,000 was to have been delivered in October, but did not reach Germany until the following February. It had been sold by a German house dealing in American machines, with the agreement that it was to be delivered in November. The result was a suit against the dealer, in which damages for about $2,000 were demanded, and, in turn, the middleman claimed similar damages against the American manufacturer.

To prevent breakage during shipment, all machines and parts of machines should be boxed, when possible, and the cast frames bolted securely to heavy timbers. In some of these machines there can be no doubt that the castings are too light for export without careful packing. Contracts should be made in writing when practicable, and should leave no doubt as to where the responsibility of the exporter ends and that of the German importer begins. In several cases, I have found that the American claimed that his responsibility ended when he placed the goods aboard ship in New York Harbor, while the German importer alleged that the goods were to be delivered here in good condition. These points should be fully covered in the contracts, and in cases where regular customers order by cable from catalogues, standing contracts covering all these points should be entered into. Much trouble will also be avoided by detailed specifications, which will prevent disputes as to particular parts of machines, and by the delivery of goods within the specified time. Special care should be taken that the bills of lading show clearly that the machines are in good order, and forwarding agents should be given special instructions to carefully examine them at the seaports for cracks, bends, and breaks, in order that the responsibility for damage may be easily fixed. While the transportation companies can be made to pay for goods damaged in transit, the shipper will experience many difficulties in compelling settlement where all of the facts are not clear, and where claims are resisted.

Düsseldorf, being the financial center and largest city of the great iron and coal district of the German empire, has become the leading place in the country for the sale of American machines and machine tools, and a number of firms employing large capital are engaged exclusively in the importation of these goods. Some of these firms—in fact, nearly all of them—remove the plates showing the names of the American manufacturers and replace them with plates bearing their own names as the makers. To avoid all of these difficulties and save the profit of the German middleman, a number of American manufacturing firms have opened permanent offices in this city, with American engineers in charge, where plans and specifications are prepared, estimates made, and contracts entered into. This system is very much more satisfactory to both the manufacturer and the German firms which buy the machines for use. There can be no doubt that many other American machine-tool manufacturers could profitably increase their business by opening offices here, with competent engineers and solicitors.

United States Exports to Turkey.—Consul Marshal Halstead sends the following, dated Birmingham, March 22, 1899:

"When the Americans once secure a hold on the markets of the Levant, their vast resources, their business capacity and energy, and the vigilance of their consuls will give them the lead in many classes of goods."

This is the last sentence in a special dispatch, with Vienna date, published in The London Times this morning. The touch of expectation that the vigilance of American consuls will be a factor in this new business drifts into The Times dispatch so naturally that I use it to call attention again to the opinion so generally entertained in Great Britain and on the European continent, that the American consular service is unexcelled. At the same time, there is much information in the dispatch that is important commercially, and I give it below in full:

"[Special dispatch to London Times, dated March 22, 1899.]

"THE UNITED STATES AND TURKEY.

"I have had more than one opportunity of sending information published by the Deutsche Zeitung, of Vienna, on the active political and commercial propaganda of some of the great powers in Turkey. The same journal now gives a very interesting account of the manner in which the United States is endeavoring to extend its influence in that direction. Sooner or later the European powers will find in the Americans a dangerous rival in the eastern markets. The ground has been prepared already by extensive missionary work. Throughout the whole of Asia Minor and its hinterland there are American missionary establishments, which, like everything American, are organized on a practical basis. Their headquarters are at Smyrna in the west and at Mosul in the east. To each mission schools are attached where children learn reading, writing, and arithmetic, and are trained as skilled workmen. At Marash, for instance, there is an artisans' school, where no fewer than 1,000 children are being educated.

"Hitherto, commercial relations between the United States and Turkey have been of small importance. Ships sailing under the American flag are not frequent visitors at Turkish ports. The last statistics issued, those of the year 1896-'97, show that not a single American vessel arrived in the Turkish harbors. Formerly, they used to take petroleum to Turkey; but Russian competition has driven the American oil out of the field. Since the beginning of this year, however, a direct line of steamers between New York and Constantinople has been organized, which promises to stimulate commercial intercourse between the two countries. American goods now no longer require to be transshipped in English or American ports, and this, of course, greatly reduces the cost of transport. The merchandise exported from America to Turkey consists principally of raw iron, hardware, tools, agricultural machines, and other iron manufactured goods, rum, beer, and flour. At the beginning of the year, 1,000,000 kilos. (2,204,600 pounds) of American flour had been imported into Turkey, whereas French and also Hungarian flour had been refused entrance at the custom house. The Americans import from Turkey opium, skins and hides, carpets, and cotton of Egyptian growth.

"The industrial states of Europe, and, foremost among them, Austria-Hungary, are warned by the Deutsche Zeitung of the danger with which they are threatened by American exportation. When the Americans once secure a hold on the markets of the Levant, their vast resources, their business capacity and energy, and the vigilance of their consuls will give them the lead in many classes of goods."

The United States minister at Constantinople, Mr. Straus, says, under date of March 27, 1899:

I have every reason to believe that if enterprising American houses would study this market and establish agencies under American representatives, they would in the course of a short time do a profitable and, in many products and articles of manufacture, a large business. But, in order to extend such trade, it would be advisable to send in the first instance agents with American energy and reliability. A knowledge of the French or German language, or both, would be of great advantage.

Packing for Venezuela.—Consular Agent De Sola writes from Caracas, under date of February 15, 1899:

I cannot too strongly urge United States manufacturers to effect a radical change in their system of packing. The cases and crates are in many instances not strong, but are very heavy, owing to the thickness of wood employed. This is prejudicial, not only on account of the breakage, but because the customs duty in this country is collected on the gross weight.

Broom Handles in Great Britain.—In a report printed in Advance Sheets of Consular Reports No. 366 (March 6), I stated, says U. S. Consul Marshal Halstead, of Birmingham, that there was a great demand for and inability to procure American broom handles here, and that I would like to know why there should be that scarcity. Under date of March 10, I have received the desired explanation, very graciously volunteered by a gentleman in the United States, who evidently is thoroughly well posted, and his letter contains so much that is of interest that I give it below. He says:

"I have been in the past a very large handler of American broom handles. I have shipped a great many thousands—yes, hundreds of thousands—to England during the last fifteen or eighteen years, but have not done very much for the last six or eight years, for the reason that they cannot be sold in England at a price that will yield any profit to either the manufacturer or shipper. The broom handle that the trade wants in England is not what is known as a broom handle in this country. The English broom handle is used for a floor brush, and must be 42 inches long, 1⅛ inches in diameter, and the same size at both ends. An American broom handle is 38 inches long, seven-eighths of an inch in diameter at one end, tapering to three-fourths of an inch at the other. You will find by figuring it out that the English broom handle takes, including the saw kerf for cutting it out of the lumber, a blank that is 1¼ inches square and 42 inches in length, which, figured out in the board measure, is about six-tenths of a square foot, and this is figuring very closely. When you understand the fact that the English merchants expect, or rather want, to buy the English style of broom handles at about from $15 to $18 per thousand f. o. b. steamer and made of white spruce, and that the lumber from which these handles have to be cut is worth from $23 to $24 per 1,000 feet in the boards, you can at once see that the handles will not bring as much money all turned and delivered to the vessel as the boards themselves would bring at the mill.

"Another reason why the handles are scarce is the fact that the English people will insist upon having nothing but white spruce, whereas the broom handles that are used in this country are either birch or basswood. I have tried very hard in my experience to introduce the American basswood handle into England, but they simply won't have it. Therefore, the high price of the spruce in this country and the fact that it is growing scarcer and scarcer every year is the reason why there is an insufficient supply of broom handles in England."

In the same mail which brought the New York explanation, I received from an American in Hamburg, who is doing business there as an agent for a United States manufacturer, a letter in which the following paragraph occurs:

"The reason why broomsticks are so scarce is probably this, that there has been an unexpected boom in brooms in the United States. The price has gone up 25 per cent. within a few months, which is quite unusual for such a staple article, and my manufacturers are in consequence four or five months behind in their deliveries. Another reason is that for broom handles, long, straight spruce or basswood sticks are required, and they must be well seasoned in order not to crack. The boom has unquestionably taxed the manufacturers to the utmost, and their kilns are no doubt full and cannot be emptied before the wood is thoroughly seasoned."

Some months ago, I met in London an American citizen of Swedish nativity, whose relatives in Sweden have for many years derived their income by the sale of spruce timber from their lands, and he told me they wrote him that not only was spruce almost exhausted in their neighborhood, but pretty generally throughout Sweden and Norway. I have presented these facts to the manufacturer of brushes here who made the inquiry for broom handles, and I am anticipating that, as he must see, in the near future it will be necessary for broom manufacturers to abandon the use of spruce, he will consent now to make an experimental use of basswood.

Shoes in China.—The following is the substance of an article which appeared in the Leipziger Tageblatt of March 10, 1899:

"China is, at the present time, a country with which all commercial nations are endeavoring to establish trade relations, and Germany, since its acquisition of Kyao-chau, is in the lead in the struggle for commercial supremacy.

"There is no doubt that the Chinese empire, with its enormous population, offers a splendid field for exporting many of the products of this country. The question arises whether or not shoes are among those articles which can be profitably imported into China. Trials should be made in this direction, by all means, for what ground is not covered by Germans, the English and Americans will take at once.

"Of course it must be remembered and seriously considered that the Chinese, as a nation, have a distinctive clothing for the feet; but there is no reason why we cannot make the kinds of shoes and after the patterns desired. Again, it is to be expected that through the influence of Europeans, who are constantly increasing in numbers in China, European foot wear will come into fashion.

"Already, there are a number of firms in China which import German goods. They have their own branch houses in the large commercial centers, and several of them have established agencies in Germany. Through the medium of such firms, the experiment of exporting shoes to China could be tried without great difficulty or expense. It may be that there is a large business to be done in this line; at any rate, an earnest and fair trial should be given."

The newspapers of this country, undoubtedly inspired by the chambers of commerce, are urging the merchants to exert themselves to obtain a firm commercial hold in China in almost every line of goods, with the result that Germany, within the past year, has increased her exports thither enormously.

This morning I, says United States Consul Brainard H. Warner, Jr., of Leipsic, had occasion to call upon several parties who had just returned from China, one of whom had the following to say about the shoe trade in that country:

"I am very certain that any attempt on the part of the manufacturers of Germany or of America to manufacture Chinese shoes to be imported into China would prove a failure, because of the prevailing low prices for which such articles are sold in that country. A good substantial pair of Chinese shoes can be purchased for what would amount to about 20 cents in American money. In a very large number of Chinese families of the poorer classes, the shoes for the entire family are made by the wife and mother. The Chinese are slow to adopt foreign customs and habits, and I am sure it will be many years before they can be induced to wear our shoes. Of course, as the newspaper article says, the foreign population in China is growing very rapidly from year to year and should be taken into account. It would certainly be a good idea, in view of this, for shoe manufacturers to pay careful attention to the Chinese markets, for the purpose and with the aim of extending their trade. American shoes are well known in China. They are sold there to some small extent through English houses, and, were it not for the very high prices which are asked for them, many more would be sold."

It has been proved by our shoe manufacturers that they can compete with those of any other country as regards price and quality, and for this reason, they should watch very carefully for openings in foreign countries where there is any likelihood of their products being sold.

Another point: Our exporters should be careful to see that the retailers have a uniform price for their shoes, and that it should not be excessive, as is sometimes the case. Dealers in American shoes in foreign countries give as an excuse for exorbitant charges the fact that they have so little call for them. Remedy this fault, and our shoes will become very much more popular than they are to-day. Exporters of shoes and leather goods, in preparing shipments for China, should remember to pack so as to suit the climate.

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No. 407. April 22.—*United States Exports to Turkey—All-all Trade in Great Britain—*Broom Handles in Great Britain—Notes from Northern Brazil—Potato Bread for Horses in Germany.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

ELECTRICAL NOTES.

Sand will be used to extinguish fire, if there should be one in the New Telephone Company's exchange at Indianapolis. It is used because it is less injurious to the electrical apparatus than water or chemicals would be. The sand is stored in a large tank above the exchange room, and is sifted automatically to any or all parts of the building in such a manner as to smother fire very effectively.

Press reports state that the Rochester and Lake Ontario Railroad (the Bay road), running between Rochester and Irondequoit, on Lake Ontario, a distance of six miles, will change its motive power from steam to electricity. This company runs three locomotives, nine passenger and a few freight cars. In 1893 it was leased in perpetuity to the Rochester and Irondequoit Railroad Company, which company was leased for ten years from April 15, 1898, to the Rochester Railway Company.

The number of motors required for the conversion of the Third Avenue Railway, in New York, from cable to electric traction will be 1,830. There will be 560 cars, 350 of which will be very large cars, each equipped with four 30 horse power motors. The remaining 210 will be supplied with two 40 horse power motors each. It is an interesting point of comparison that one American tramway should require more motors and electrically operated cars than there are at the present time in the whole of Great Britain.

What will be one of the largest ventilating fans in the world has been ordered for the purpose of ventilating the Hoosac Tunnel. The fan will be 16 feet in diameter and 8 feet wide, and will be driven by an electric motor, says The Electrical World and Electrical Engineer. It will have a capacity of drawing 600,000 cubic feet of air per minute, and when it is in operation, it will clear the smoke, gas, and impure atmosphere from the tunnel. The clearer atmosphere in the tunnel will enable the trains to attain higher speeds.

Some time ago soundings were made between the United States and Hawaii to Guam, and now the series is to be completed to Manila by the "Ranger." Commencing at Guam, the course will cover 6,000 miles, and the deep sea soundings are to be taken at intervals of 10 miles, the Sigsbee sounding machine being employed in the work. A wire of 0·03 inch diameter, with a breaking strain of a little over 200 pounds and weighing 13 pounds to the mile, will be used. The temperature at great depths will also be taken, in view of probable cable developments, and for this purpose a modification of the Negretti-Zambra thermometer is being adopted.

At the February meeting of the Société Internationale des Electriciens, the president, M. R. V. Picou, stated that the remains of M. Lucien Gaulard, one of the inventors of the alternating-current system, who died ten years ago in poverty, had found a resting place in a "concession provisoire," the term of which was about to expire. In consequence, a movement had been put on foot for the purpose of transferring the remains to a concession in perpetuité, and erecting thereon a monument to the memory of the great inventor, says The Electrical World and Electrical Engineer. The ground for this purpose has already been secured, and a number of French professional and industrial bodies are securing subscriptions from their members to defray the cost of an appropriate monument.

United States Consul W. K. Anderson, at Hanover, Germany, says that the electric street railway of Hanover was built under the supervision and direction of an American from Philadelphia, and was opened for business on May 1, 1893. It was one of the first electric lines inaugurated in Germany, and is now one of the best systems. The cars are modeled after American ones, and the tracks are of heavy steel laid on a substantial foundation of concrete. The fare for a course of, say, 2 miles within the city limits is 10 pfennigs, or less than 2½ cents of our money. Universal transfers are granted. The speed is about 8 miles an hour, and the cars run smoothly and with but little noise. Within the mile circuit and upon some of the principal streets extending to the city limits the cars are run on the accumulator system; but when the outskirts are reached the accumulators are released from service and the cars are run by overhead trolley. The lines extend on almost every road miles into the surrounding country. The trackage of the Hanover Electric Railway now amounts to over 105 miles. The equipment consists of 41 overhead trolley cars, 161 accumulators and trolley cars combined, 167 trailers, 20 locomotives, 4 sprinklers, and 24 freight cars. There are 6 power stations, 4 of which furnish, in addition to power for the cars, electric light for streets and roads. The motor cars are from 17 to 34 horse power and the locomotives 50 horse power each.

Among the battered flotsam and jetsam that has accumulated in a second-hand store not a great distance from Jackson Square, says The New Orleans Times-Democrat, is a shabby round table with a curious secret, and no doubt a still more curious history. The top was once covered with green billiard cloth, which now is worn to tatters, and discloses a steel plate set in the center and perhaps ten inches square. The whole top is loose and can be removed, revealing an interior space containing a horseshoe magnet wound with wire and connected with an armature very much like that of an ordinary telegraphic instrument. A close examination shows an insulated wire running down one of the legs to a small knob or button, protruding on the outside. When the top is in place, the steel plate rests directly over the magnet. This strange device is explained clearly enough by its present owner. "It is a dice table," he said, "on which a lot of money has been won. When it was in order there was a good-sized battery inside, connected with the magnet. When the knob on the leg was pressed, the current was turned on, and that made the steel plate magnetic. The dice they used with it had small metal disks on one face, and as long as the current was on they naturally fell that side down. When the knob was released they would fall any way they chanced to come, so all that was necessary for the operator to do was to keep his knee on the button and he could absolutely control his play."

MISCELLANEOUS NOTES.

In reply to inquiries by a Massachusetts correspondent, Consul-General Gowey, on February 20, 1899, writes from Yokohama: The plant used in Japan in the manufacture of straw carpets or matting is known as igusa or goza gusa (Juncus effusus), a species of rush widely distributed throughout the northern hemisphere. Its cultivation resembles that of rice. It grows in rows in swampy ground and is propagated by means of rhizoma cuttings. It is set out in the spring and harvested in August, when about 3 feet high. It is cut close to the ground, dried, and put under cover until needed, when it is moistened, and the epidermis is then rubbed off with ashes.

Consul Ravndal sends from Beirut, February 17, 1899, a description of the preparation of sesame oil in that country. The grain, he says, is soaked in water for twenty-four hours and then placed in an oblong pit coated with cement, in which two men work a wooden hammer of twenty pounds weight. Efforts are made not to mash the kernels. The skins are separated in a tub of water salted to a degree sufficient to float an egg; the bran sinks while the kernels remain on the surface. The sesame seeds are now broiled in an oven and sent to the mill to be ground. From the millstone, the oil drops into a jar. It is thick, of a dark-yellow color, and sweet. The product is used extensively by the poorer classes in place of cheese, sirup, honey, etc., and is popular on account of its saccharine properties. Confectionery is made by mixing sesame oil with sirup and other elements. Sesame is widely cultivated in Syria. The average price is 8 cents per oke or 2¾ pounds. The sesame grain is largely employed in flavoring pastry. The wholesale price of oil is at present 14 cents per 2¾ pounds.

It is pointed out by The London Daily News that, within the last eighteen years, 8,670,120 square miles have been added to the colonial empires of the great colonizing powers. This total, which does not include Egypt or the Soudan, is made up as follows:

	Square Miles.
Great Britain	3,987,312
France	2,936,563
Germany	1,020,070
Russia	265,381
United States	160,601
Netherlands	123,677
Portugal	96,605
Spain	79,911

Even Spain, in spite of the loss of her best colonies, has increased the colonial area she governed in 1880. Denmark alone among the old colonial powers has not added more territory to her oversea possessions during the present century. It is interesting to note that the total colonial area is 7·7 times larger than the total areas of the home governments. In the case of Great Britain it is 75 times more than her local home area; in that of France nearly 18, Portugal 22, the Netherlands 65, Germany 5, and Russia 3 times as large as their home area.

American lanterns are exported to all the countries of the world where lanterns are used. Many are sent to South Africa and to South America, to Australia and New Zealand, and some are sold in Asia. Few, proportionately, are sent to Europe. Kerosene oil is now commonly burned in lanterns all over the world. There are no lanterns made nowadays for candles only, but there are exported to South America some lanterns made so that either candles or oil may be burned in them. These are provided with a candle socket which may be set down into the oil reservoir, the wick holder having been removed. By removing the candle socket and screwing in the wick holder the lantern is made ready to burn oil. Excepting railroad and other lanterns for special uses, substantially all the lanterns made nowadays are of the kind known as tubular, first introduced about thirty years ago, and now made in various modifications as to detail, the tubular part of the lantern being designed with a view to producing better combustion and a brighter light. The lanterns made for ordinary uses are produced in about forty styles. The American lanterns are the lightest, the sightliest in appearance, and the best adapted to their use, and they are sold cheaper than lanterns of equal quality produced elsewhere. There are large establishments in this country making lanterns only. It is probable that more lanterns are now exported from this country than from either England or Germany, and the exports of American lanterns are increasing.—American Exporter.

In a recent issue of the Zeitschrift des Oesterr. Ingenieur und Architekten Vereines is given an illustrated account of the interesting plant installed in the great market buildings at Vienna, which, though there are other and as important plants elsewhere, possesses features that render it worthy of notice. As the plant is intended merely to maintain a low temperature without reaching the freezing point, thus providing storage rooms cool enough to insure the proper preservations of meats and other market articles, and at the same time avoiding the objections of too low a temperature, the indirect system is adopted, cooled air being distributed through the storage chambers by a forced circulation. The refrigerating machines used in this especial case operate with carbonic acid gas, the gas being compressed to liquefaction and the heat of compression removed by water, after which the liquefied carbonic acid is permitted to expand again to the gaseous state in coils in brine tanks, the brine thus being lowered to the desired temperature, while the expanded gas is returned to the compressors to complete the cycle. It is evident that any of the accepted forms of refrigerating machines might be used in this manner, the choice depending upon local conditions. The cold brine, instead of being circulated through coils of pipe in the storage chambers, is permitted to flow over a series of pans or trays arranged in layers in a special chamber, and the air is drawn through the spaces between the trays and thus cooled before being delivered to the storage vaults. The circulating fan, placed at one end of the chamber in which the cooling trays stand, draws the air from the storage rooms through the spaces between the trays and delivers it again into the vaults, the same air thus circulating continuously, in a direction opposite to that of the cold brine over the trays.—Engineering Magazine.

SELECTED FORMULÆ.

Solder for Glass.—According to the Gold and Silberwaren Industrie, a metallic compound which firmly adheres to glass, and can be employed as a solder, is obtained by melting together 95 per cent. (by weight) of tin and 5 parts of zinc. The melting point lies at about 200°. By means of the soldering iron it can be spread upon the glass, previously heated to this temperature, and, after cooling, adheres firmly to it. An alloy of 9 parts tin and 1 part aluminum may be used for the same purpose, but has the drawback that its fusing point lies considerably higher, viz., around 390°.

Washing Liquids.—

I.

Sodium carbonate in concentrated solution, rendered caustic by agitation with slaked lime. Must be used with discretion.

II.

Alcohol	8 parts.
Oil of turpentine	8 "
Strongest solution of ammonia	1 "

Mix. Use three or four tablespoonfuls to one pint of soft soap, or one pound of hard soap. The clothes should be soaked over night if possible, before using this mixture, but if soaked an hour or two it will aid much.

III.

Washing fluid for fine linen, laces, etc.:

Borax	1 part.
Water	160 "

For crinoline or any stiff fabric, increase the quantity of borax to 6 ounces.

IV.

Nottingham washing liquor:

Water	42 parts.
White soap	8 "
Potassium carbonate, impure	1 "

V.

Hull washing liquor:

Yellow soap	3 parts.
Water	256 "
Strongest solution of ammonia	8 "

VI.

Yorkshire wash:

Strongest solution of ammonia	1 part.
Common water	16 "

VII.

Silicate of soda or potash, or water-glass, is in itself a good detergent. It is added to cheap soaps to permit the retention of large quantities of water in the finished product. The retail druggist should not attempt to manufacture the article. It is purchased in casks, and is a thick, viscid, translucent mass, flowing very slowly. When dissolved in hot water it forms a solution which unites with certain kinds of soap very readily (curd soap, yellow soap, and soaps containing resin). Probably a useful washing liquor could be made from this substance.

VIII.

Quillaia, or soap bark, is worth attention in this connection. Dried soda, 77 parts, quillaia bark, 23 parts, in powder, have been recommended in Germany as a salable washing powder.—National Druggist.

Waterproofing Canvas or Cloth.—The following formulas have been recommended:

1. Linseed oil, boiled | 3 gallons.
   Spirits turpentine | 3 pints.
   Patent driers | 3 ounces.
   Powdered sulphur | ¼ "
   Yellow ocher (or other pigment) | q. s.

2. Grind 96 pounds of English ocher with boiled oil, and add to it 16 pounds of black paint. Dissolve 1 pound yellow soap in 1 pail of water on the fire, and mix it, while hot, with the paint. Lay this composition, without wetting it, upon the canvas as stiff as conveniently can be done with the brush, so as to form a smooth surface; the next day, or the day after (if the latter, so much the better), lay on a second coat of ocher and black, with a very little, if any, soap; allow this coat a day to dry, and then finish the canvas with black paint.

3. A solution containing equal parts by weight of gelatine and chrome alum. It is not advisable to mix more of the solution at once than is sufficient to give the canvas one coat, as, if the mixture once sets, it cannot be reliquefied like a plain solution of gelatine, and hence, if the quantity of the canvas to be waterproofed is but small, it would, perhaps, be preferable to coat with plain gelatine solution until quite impervious to cold water, and then to thoroughly soak for say twenty-four hours in a strong solution of chrome alum.

4. Sodium carbonate | 1 pound.
   Caustic lime | ½ "
   Water | 2½ pints.

Boil together, let it stand to settle, then draw off the clear lye and add to it 1 pound tallow, ½ pound resin, previously melted together. Boil and stir occasionally for half an hour, then introduce 3 ounces glue (previously softened), 3 ounces linseed oil, and continue the boiling and stirring for another half hour. In waterproofing, ½ ounce of this soap is mixed with 1 gallon hot water, and in this the goods are soaked for about twenty-four hours, according to thickness and character. The pieces are allowed to drain until partly dried, then soaked for six hours or more in a solution prepared as follows:

Aluminum sulphate	1 pound.
Lead acetate	½ "
Water	8 gallons.

Shake together, allow to settle, and draw off the clear liquid. Wring out after rinsing and dry at a temperature of 80° F.—Pharmaceutical Era.

Macassar Oil.—

Oil almond, expressed	1000·00	grammes.
Oil bergamot	3·00	"
Oil lemon	1·00	"
Cumarin	0·05	"
Oil alkanet, q. s.		

Olive or earth nut oil may be used instead of the almond oil.

FLAMMARION'S OBSERVATORY.

THE conquests of science have wonderfully changed our conception of the universe. Our predecessors had no idea of its magnificent beauty and harmony. They imagined the stars to be the golden heads of a like number of bolts riveted in a dome, and they thought our little earth to be by itself the whole creation.

How insignificant the universe of Moses, Pythagoras, Homer, and Virgil, compared to the vistas of modern astronomy! Hesiod pretended to convey an idea of the world's magnitude by saying that a falling anvil would take nine days and nights to run the distance from the sky to the earth, and as long to sweep the space intervening between our planet and the bottom of the infernal regions.

Calculation shows that nine times twenty-four hours would correspond to a fall of 581,870 kilometers only; less than double the distance from the moon, which is, astronomically speaking, a mere suburb of the earth. The sun is four hundred times farther from us than the moon; Neptune thirty times more than the sun; and the nearest star nine thousand times farther than Neptune. The old universe was a pod of a silkworm, a starry cell having no room for modern thought. In the silence of the beautiful night, our mind, enlightened by science, flies toward those infinite depths, and feels itself free from meanness and the selfish passions of man below, and it wishes to be worthy of the celestial harmonies that hold together worlds in the field of eternity. Looking at such a magnificent spectacle, it feels incapable of a bad deed, and it cannot understand how intelligent beings can fight one another, impelled by hate of race and religion.

What an immensity! Were we to travel in an express train running at the rate of 60 kilometers per hour, and in a straight line toward the nearest star, without stopping, we would not reach it till the end of seventy-five millions of years. Flying with the fastest projectile invented by man to exterminate his fellow beings, and going with a velocity twice that of sound, six hundred and eighty meters per second, we would still require one and a half millions of years to traverse the distance. Should that star explode, and could the sound of the catastrophe be transmitted to us with the known velocity of sound through air, we could not hear it until after three millions of years, and we could not see the light of the explosion until four years after it had occurred.

We are speaking in regard to the nearest star of our celestial neighbor, the star Alpha of the Centaur, placed at two hundred and seventy-five thousand times the distance from the earth to the sun, or in other words, at fifty-one billions kilometers. All its other stars are still farther away; ten, twenty, fifty, one hundred times, etc., up to infinity. These comparisons may give us an idea of the immensity of the universe, and allow us to appreciate the insignificance and almost nonentity of our planet in the real world.

We would arrive at the same result comparing the size of our globe with the dimensions of the stars. Each one is a sun provided with its own light. All those that have been measured are larger than our sun, and we all know that its volume is one million two hundred and eighty-three thousand times larger than that of the earth. We must then take each one of those points in space that are seen in the celestial dome to be about one or many millions of times larger than the globe on whose surface we are living. There is no doubt that very few are smaller than our sun.

Each one of those suns, the center of unknown systems, runs through space at a formidable velocity. Our planet revolves around the sun, covering a distance of more than one hundred thousand kilometers per hour. We are attracted by the sun toward the Hercules constellation at a velocity calculated as three hundred millions of kilometers per year, and the velocity of the Alpha star of the Centaur seems to be double that amount; a star of the Ursa Major runs through immensity with a velocity of thirty millions of kilometers per day, and all of the other stars are attracted the same way, although, on account of their distance, they seem to us absolutely fixed.

We have just said 30,000,000 per day; 1,250,000 per hour, 20,800 per minute, 340 per second. Could we imagine a projectile running through the infinite vacuum at a velocity of more than three hundred thousand meters per second? Five thousand times the velocity of a cannon ball. All the stars run through space impelled by energies more or less powerful, and from century to century all constellations are displaced, although in the millions of years during which humanity has been observing the configuration of the sky it has not varied in its general aspect. These movements and these luminous radiations, so diversified, are but the

M. CAMILLE FLAMMARION IN HIS OBSERVATORY.

symbol of a life truly wonderful. In these last years the configuration of the sky has suffered, as it were, a new transformation through the marvelous discovery of the spectral analysis, permitting us to know the chemical composition and the physical constitution of the most distant celestial body and to appreciate its temperature, velocity, and relative age. At the same time celestial photography permits us to register on the sensitive plate bodies hardly perceptible through the telescope, and stars so feeble and so obscure that they would have been hidden forever from our eyes had it not been for the assistance of photography. Photography, then, has given to modern science a new organ, while the investigations of celestial mechanics have revealed the existence of extinguished stars that are, nevertheless, acting through their attraction on the brilliant stars, deflecting them from their course.

Thus has science transformed for us the aspect of the sky. Let us contemplate it, study it, trying to understand the general scope of nature, and the real situation of our planet and character of the people who are living on it. The study of the universe is the study of ourselves. Astronomy affects us more than we think. We are really living on a celestial body, the third of the planets that revolve around the sun, and each star, a sun by itself, is a center, a focus of light, of heat, of activity, and of life. How strange that almost all the inhabitants of the earth have lived up till to-day not knowing where they were and without suspecting the wonders of the universe. The sky picture is the grandest of all pictures, and the book of the heavens the most interesting of all books. Let us contemplate such a picture! let us read such a book. We will thus become more intelligent, noble and better.

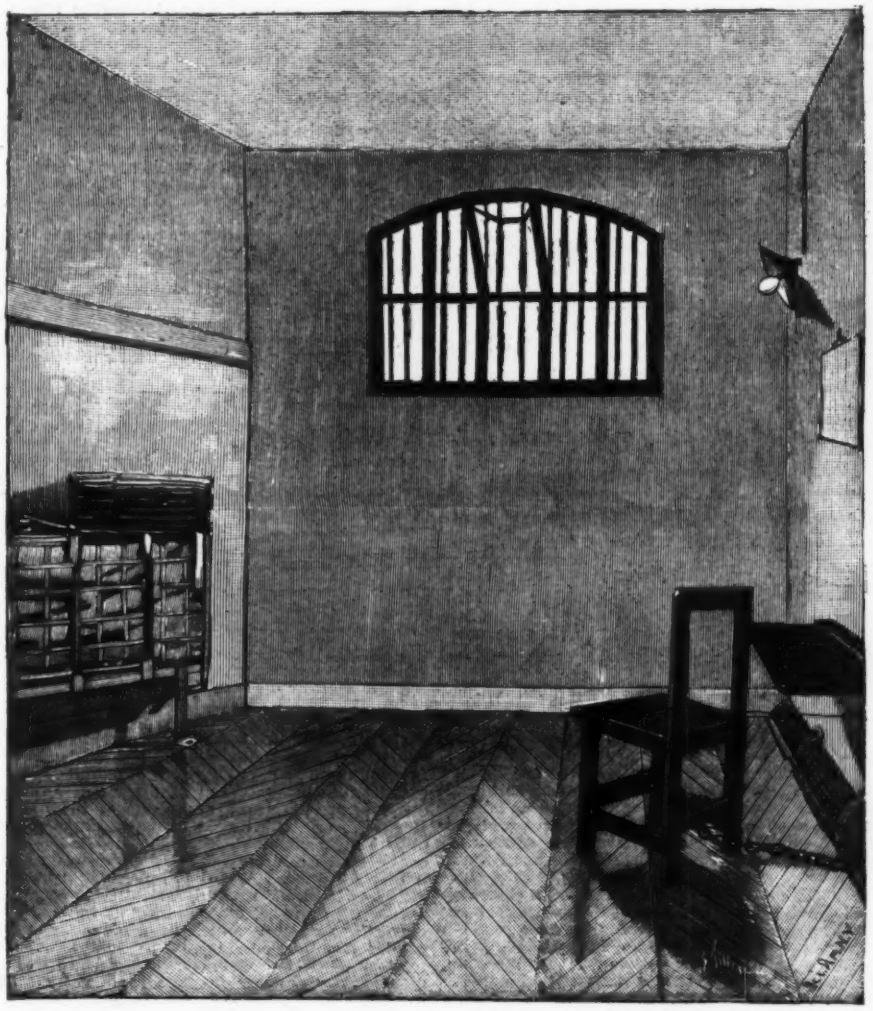
CAMILLE FLAMMARION.

THE NEW CELLS OF THE SANTÉ PRISON.

THE Santé Prison underwent some important changes last year. It formerly comprised two wards, one of them being provided with ordinary cells and the other being of the character called "Auburnian." It is the latter that has been changed, and converted into a cell ward. The work consisted in the reconstruction of the internal partitions, in the construction of new cells, and in the addition of another story to the old buildings. The cost was two million francs.

The new ward, which consists of a quadrilateral and a transverse structure, along with a central building connecting the new structures with the old, is now provided with 683 cells arranged upon four floors and accessible through balconies supported by brackets. These new cells, which are formed through the union of two of the old ones, constitute relatively spacious rooms, which are 13 feet in length, 12 in width, and 10 in height. They are provided with parquetry flooring finished with wax. The walls are covered with a lacquer composition, so as to permit of frequent washing. A double system of piping leads spring water to the cells for the requirements of the prisoner and river water for flushing purposes. Fans driven by electricity assure a perfect ventilation; incandescent lamps furnish the light; and a steam generator supplies the heat. Wide windows descending to within three feet of the floor furnish an abundance of light.

The furniture consists of an iron bed sealed into the wall and provided with a mattress and bolster. Hinges permit of turning this up during the day and securing it against the wall. To the wall is fixed a hinged shelf, which also may be raised or lowered. The single chair with which the cell is provided is secured by a chain of sufficient length to permit of its being shifted about but too short to allow the prisoner to use the chair as a weapon with which to strike his keeper. In one corner is situated the arrangement that is indispensable for the use of every human being. Finally, near the door is placed the electric button which the prisoner presses in order to call the keeper.



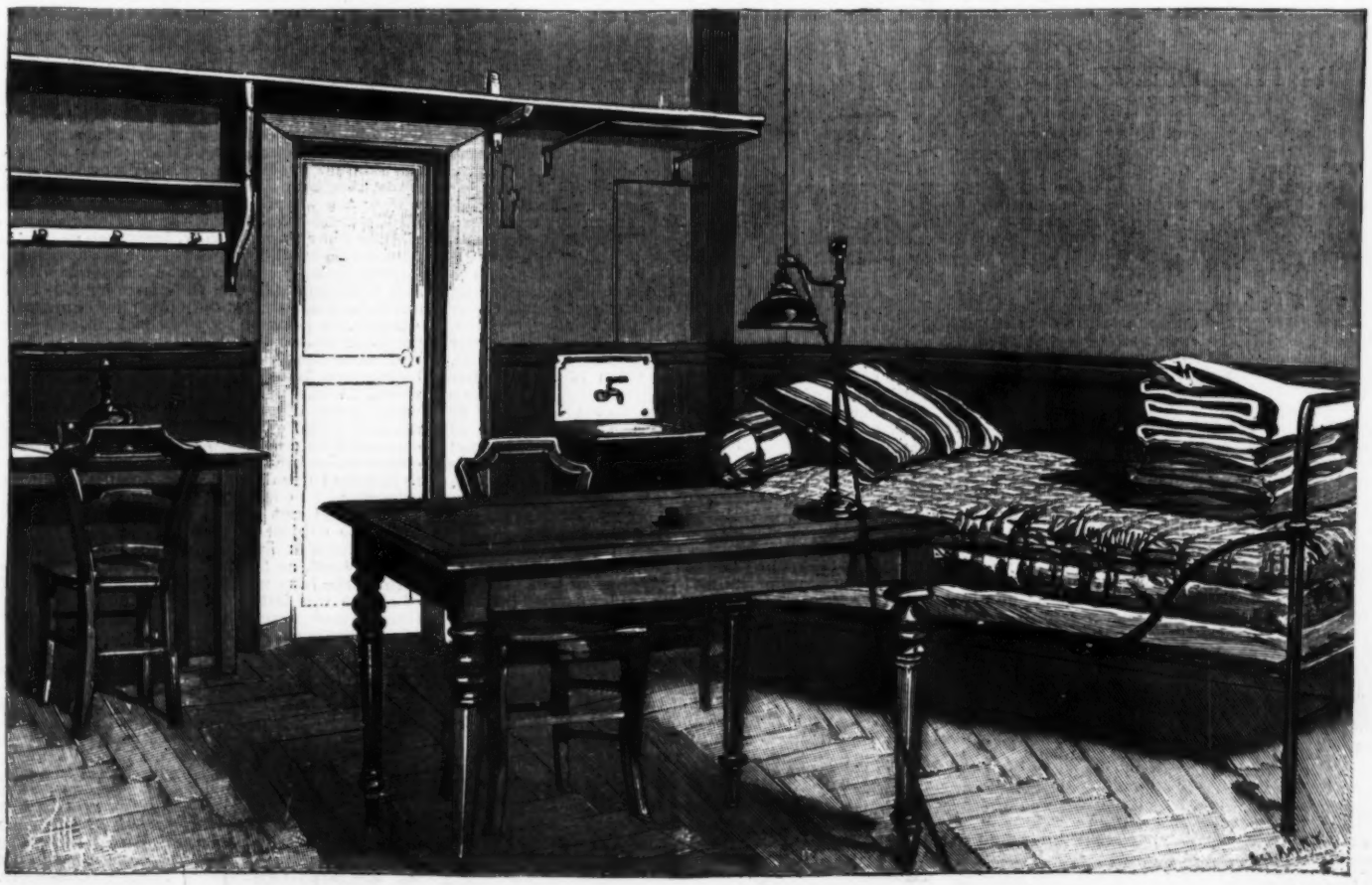
CELL OF A COMMON LAW PRISONER.

It was in one of these cells (in the seventh division) that Lieut.-Col. Picquart was a short time ago incarcerated.

The quarters set apart for political prisoners consist of eight cells that an endeavor has been made to render as comfortable as possible. The walls are tapestried and ornamented with woodwork up to the height of the breast. The bed is provided with two mattresses.

There is a wide oak work table, and a smaller table of whitewood for dining purposes. The latter is provided with a table cloth. A bedside table, with a drier for napkins, three chairs, and the ordinary accessories of a cell complete the furniture.

The light is furnished by incandescent electric lamps,



THE SANTÉ PRISON—CELL OF A POLITICAL PRISONER.

one of which is suspended from the center of the ceiling, and the other is placed upon the work table.

For the above particulars and the engravings we are indebted to L'Illustration.

UNIVERSITY OF PENNSYLVANIA LECTURE COURSE.

PECULIAR LAWS AND CUSTOMS IN THE AMERICAN COLONIES.*

THE late Prof. Freeman once remarked that the chief difference between the Americans and Englishmen was that the former had migrated twice. The colonization of North America has been aptly characterized as the transplanting of Englishmen and English institutions. Speaking generally, this is true. It is a fact that the colonists brought with them not only their language and habits of thought, but also the legal, political, and social customs and usages of the England of their time, as far as they were applicable to their new environment. As every student knows, the early laws of the different English colonies in America were in large measure what the laws, the state of religion, and the customs of the mother country had made them. It is my purpose, in this lecture on some of the peculiar laws and customs of the colonies, to direct your attention, particularly, to the relation of the state to the individual, or the government to the subject, or the citizen, as presenting some interesting and striking contrasts to the theory and practice of the present day, considering the subject first in its more general bearings and, later, with reference to the peculiar features of the penal laws and punishments of the time.

In the age which witnessed the colonization and development of the thirteen colonies paternalism in government still held sway. The material, religious, moral, and social affairs of the community were closely regulated. Scarcely anything was too small to be overlooked, or so unimportant as to be unprovided for. This theory of government was recognized in all the colonies, but probably it was carried to the greatest extent in practice in New England. Among the most striking illustrations of the paternalistic idea are the so-called sumptuary laws, or laws for the regulation of dress and expenditures, borrowed not only from England but from general European legislation. Prof. Vincent, in a recent article on Europe and blue laws, has shown that such laws were "not the peculiar product of Puritanism, or even of the Reformation;" but conspicuous examples of sumptuary legislation may be found in continental Europe from the opening of the fourteenth to the closing years of the eighteenth century.

Scarcely had the Sabbath-keeping, church-going Puritans been in their wilderness home five years when some of their number seem to have been so far in thraldom to the world, the flesh, and the devil that they were guilty of excess in aping the fashions of the mother land. Accordingly the Great and General Court of Massachusetts Bay in 1634 felt constrained in view of "the greate, supflous, and unnecessary expences occaconed by reason of some newe and imodest fashions," to order that "noe person, either man or woman, shall hereafter make or buy any apparell, either woolen, silk, or lynnen, with any lace on it (silver, golde, silke, or thread), under the penalty of the forfecture of such cloathes; also noe person shall make or buy any slashed cloathes, other than one slash in each sleeve and another in the backe; also, all cutt works, imbroydered or needle-worke, capps, bands & rayles, gold or silver girdles, hat bands, belts, ruffs, beavr hatts, are prohibited to be made, bought or worne hereafter." Those already in use might be worn out, "except ye imoderate greate sleeves, slashed apparell, imoderate great rayles, longe wings &c.," which were to go at once, or be remodeled on a more modest scale. Four years later the fiat went forth against "short sleeves whereby the nakedness of the arm may be discovered in the wearing thereof;" also against "women's sleeves more than half an ell wide in the widest place, and immoderate great breches, knots or ryban, broad shoulder-bands, and rayles, silk roses, double ruffs and cuffs," since the excessive wearing of lace and every superfluity tended "to little use or benefit, but to the nourishing of pride and exhausting of men's estates, and also of evil example to others." The presence of these gayly attired ladies led the Rev. Nathaniel Ward, a distinguished Massachusetts divine, to give vent to his righteous indignation in "The Simple Cobbler of Agawam," as follows: "When I hear a nugiperous Gentle-dame inquire 'What dress the Queen is in this week, what the nudius tertian of the Court?' I look at her as the very gizzard of a trifle, the product of a quarter of a cypher, the epitome of nothing, fitter to be kickt, if she were of a kickable substance, than either honored or humored. To speak moderately, I truly confess it is beyond the ken of my understanding to conceive how those women should have any true grace or valuable vertue, that have so little wit as to disfigure themselves with such exotick garbs as not only dismantles their native lovely lustre but transclouts them into gant bar-geese, ill-shapen, shotten shell fish, Egyptian hieroglyphics, or, at the best, into French flirts of the pastry which a proper Englishwoman should scorn with her heels. It is no marvel that they wear drailes on the hinder part of their heads, having nothing, as it seems, in the forepart but a few Squirrel brains to help them frisk from one ill-favored fortune to another."

Ridicule, precept, and statute law seemed alike powerless to check this tendency to over-elegance; but by the law of 1651 it is evident that the government was more solicitous to preserve distinctions of rank than to check the extravagance of the poor; for the General Court expressed its grief that "intolerable excess and bravery hath crept in upon us, and especially among the people of mean condition, to the dishonor of God, the scandal of our profession and the consumption of estates;" hence it declared its "utter detestation and dislike that men and women of mean condition, education and callings should take upon them the garb of gentlemen, by the wearing of gold and silver lace, or buttons, or poynts at their knees, or walke in greate bootes; or women of the same rank to wear silk or tiffany hoodes or scarves, which, though allowable to persons of greater estate, or more liberal education, yet we cannot but judge intolerable in persons of such like condition." Accordingly it was ordered that no person whose visible estate did not exceed two hundred pounds should wear any of the above mentioned articles of dress, upon the penalty of ten shillings for each offense.

The manner of wearing and dressing the hair was also the occasion of much concern to the legislators of Massachusetts. From the earliest period on, the magistrates declared that the wearing of long hair was "contrary to the rule of God's word, which says it is a shame for a man to wear long hair" and that it was also "a thing uncivil and unmanly." They accordingly called upon the elders of the churches to see that their members "be not defiled therewith." Finally, in 1675, the Grand Jury was empowered to present to the county courts "such men openly appearing amongst us in long hair like women's hair, either their own, or other's hair, made into Periwigs," and such "women wearing Borders of hair," and who practice "cutting, curling, immodest laying out their hair," which practice doth prevail and increase, especially among the younger sort." But in spite of the condemnation of both church and state, wigs, or, as Judge Sewell called them, "the Horrid Bushes of Vanity," won their way into common use in New England, as well as in the colonies generally, by the close of the seventeenth century.

In view of some of the foregoing enactments, we may easily imagine how shocked our ancestors would be if they could return for a visit to the world of the present day.

Extravagance in food received, also, the reprehension of the legislature. At an early period it was ordered that "no person should sell any cakes or buns, upon pain of ten shillings fine," exception being made for "such cakes as shall be made for any buriall, or marriage, or such like special loccation." Weddings, and especially funerals, were among the most important and cherished "special occations" that made up the social life of our ancestors. The custom prevailed in all of the colonies, in connection with funerals, of giving rings, gloves, and refreshments. This grew to such proportions that twice during the first half of the eighteenth century, the General Court of Massachusetts, in view of the fact that "the charge or expense of funerals of late years is becoming very extravagant," sent forth the decree that "no scarves, gloves (except six pair to the bearers and one pair to the minister), wine, rum or rings shall be allowed and given at any funeral, upon the penalty of fifty pounds." That this exception in favor of the minister was an important one we learn from an examination of the diary of the Rev. Dr. Andrew Elliott, which contains a careful entry of the gloves and rings which he had received, recorded under each month. In thirty-two years of his ministry he appears to have received 2,940 pairs of gloves at funerals, weddings, and baptisms. After the needs of his own household of eleven children had been supplied, the superfluous gloves, as well as a goodly number of rings, were sold by the worthy parson to the storekeepers. His accounts show that he received from the sale of gloves alone a sum equal to about $640. "From all this the conclusion is irresistible," writes Mr. L. M. Sargent, who recounts the above facts, "that the truly good man and faithful minister must have been, so to speak, hand-and-glove with his parishioners."

Tobacco came in for a large share of the attention of early law makers. While in the southern colonies, as the product upon which their prosperity depended, it was the object of the fostering care of the government, in the northern colonies it met with the stubborn opposition of the authorities. The Puritans shared the prejudice of King James I., who had issued a "Counterblast" against "the detestable weed which tends to a generall and new corruption of both men's Bodies and Manners." Accordingly, in several of the New England colonies it was at first prohibited altogether; but it being impossible to enforce these laws, the authorities attempted to restrict its use. It being inconceivable to them that a man could work and smoke at the same time, and being determined, as they declared, that "no idle drone" should be permitted "to live amongst us," it was prohibited to take tobacco publicly (as by the New Haven law) on the street, or in the field, or the woods, or on a journey except one of at least ten miles, or in the house in the company of any more than one person who used it. These stricter laws gradually gave way to others (evidently prompted as precautionary measures against fire), such as the law of the Province of Pennsylvania of 1701, prohibiting smoking in the streets of Philadelphia and other towns, either by day or night, under a penalty of twelvepence fine, the same to be set apart for the purchase of leather buckets, hooks and other fire-extinguishing apparatus.

We next pass to the consideration of a somewhat similar class of laws, enacted solely to guard the morals of the people and which would now be regarded as coming within the exercise of the police power of the state. Such were the laws regulating the social pleasures and pastimes of the time. Typical of this class may be cited the law of this province of 1706, which pronounced "Prizes, interludes, stage plays, masks, revels, bull-baitings, cock-fightings, dog matches, etc., as riotous sports," and any one introducing the same was liable to a twenty shillings fine or ten days' imprisonment; and it made it a penal offense for a keeper of a public house to "permit any one therein to play at cards, dice, lotteries, tables, rowley-powley, loggarts, shove groat, shovel-board, billiards, kayles, closh-kayles, nine-pins, nine-holes, quoits, bowles, half bowles or any other kind of game whotsoever, now invented or to be hereafter invented." A more stringent act of six years later added tennis to the list of prohibitions, subjecting to a fine of twenty shillings any one who played at any of the above-mentioned games. By the so-called Connecticut Blue Laws, cards and backgammon were prohibited and foolish jesting and mixed dancing was not allowed.

In the interest of truth I may be permitted in connection with this reference to the Connecticut blue laws to stamp as false the oft-quoted fabrication of the Rev. Samuel Peters that these laws contained the provision that "no woman shall kiss her child on the Sabbath."

Another of the functions of the government in colonial days was to protect the community from exorbitant prices for either labor or goods. In all the colonies such laws were common and were based upon English precedent. A few examples will suffice to show the general practice. Thus Edward Palmer, for his extortionate charge for making the Boston stocks, was the first to fill them. In Virginia, a law of 1645, "to rectify the great abuse of the millers," provided that "no person, for the grinding of any grayne, should take above the sixth part thereof for toll." An early law of Massachusetts strikingly suggests the English Statute of Laborers. It provided that "master carpenters, sawyers, masons, mowers, etc., shall not take above two shillings a day, finding themselves dyett, and not above fourteen pence a day if they have dyett found them, under penalty of five shillings, both to giver and receiver, for every day that there is more given and received. No person shall spend his time idly or unprofitably under paine of such punishment as the court shall think meete to inflict." A little later, the General Court ordered an abatement of wages, to conform to the fall in the price of commodities, conferring upon the town governments the power to fix the wages. In the Province of Pennsylvania a law of 1721 to regulate the "mystery or faculty of tanning," and "the trade or mystery of shoemaking," provided, because "very great abuses have been committed, and the prices have become very exorbitant, and burdensome, to the people," for an elaborate system of inspection to insure the honest tanning of leather and the manufacture of shoes; and it further forbade any person taking "above the rate of six shillings sixpence for a pair of good, well-made men's shoes and five shillings for a pair of plain, well-made women's shoes," "on pain of forfeiture" of the shoes. The price of refreshments and entertainments at public houses was also fixed in Virginia by law of 1677. "The price of lodging" was "three pounds of tobacco per night" and "the price of dyett twelve pounds of tobacco, each meal, for the master, and eight pounds for the servant." The circulating medium of Virginia fluctuated in value greatly, being dependent upon the amount of the annual yield; and in consequence, many laws were passed to prevent its too rapid production. A law of Pennsylvania of 1718, after reciting that "it has been the practice of tavern keepers to exact excessive rates for their liquors and also provender for horses, without regard to the plenty and cheapness thereof," conferred upon the justices of the peace and other judges the power, at their quarterly courts, "to set such reasonable prices on all liquors retailed in public houses and provender in public stables," which price should be "proclaimed by the crier at the conclusion of the court and be affixed upon the court-house door for public view." Heavy penalties for not observing the prices so affixed were provided for.

Precaution was also taken to prevent the public being at the mercy of speculators. Thus a law was enacted in Pennsylvania in 1722 "to prevent the ill designs of brewers, retailers, victuelers, and butchers who combine to advance the prices of grain and provisions they respectively buy beyond a due proportion of the rates they give." It provided that all English statutes should be put into execution against all such combinations and evil practices. Perhaps similar legislation may be necessary in the future in view of the recent unprecedented growth of trusts and other combinations of capital.

In New England the legislation went even further in this direction. A citation of a few additional examples will perhaps reveal the essentially communal nature of early New England society and illustrate the force of Prof. Freeman's statement that "If we would see Old England, we must go to Colonial New England." There the towns possessed many of the features of the medieval guilds or trade corporations. Thus Boston protected the inhabitants against undue competition by placing a tax upon that class of persons now known as drummers. No stranger could be entertained above fourteen days without the consent of the selectmen. No one was permitted to sell his property "to any newcomers, but with the consent and allowance" of the magistrates. These laws were intended to serve a threefold purpose: First, to prevent any person, who was obnoxious on account of his religious views, from securing a home with them; secondly, to prevent the admission of any new craftsmen if there were already a sufficient number of the representatives of it within the town, on the ground that the newcomer could not make a living without injuring some of those already there; and, thirdly, inasmuch as the town was responsible for the support of the poor, to prevent any one taking up his residence in the town who was unable to support himself, thus forming a precedent for our federal law excluding pauper immigrants.

Again, to prevent its townsmen from being at the mercy of those who tried to secure a corner in grain in "ye olden time," Boston caused grain to be raised on its common lands in the suburbs and the same to be stored in the public granary on the commons, from which it was dispensed in time of scarcity at a merely nominal price. The interests of the poor were further conserved by a later law which provided that all new commodities brought into the town should be subject to sale for three days in small quantities, but at wholesale rates.

Time will not permit an examination of the laws upon the subject of religion and Sunday observance, and perhaps it is unnecessary; for it is well known that at least, as far as the Puritan colonies were concerned, the laws were very stringent and little freedom of choice was left to the individual in these matters. Sunday laws were, however, by no means confined to the Puritan colonies, but were universal and almost equally severe. New England's chief claim for distinction in this particular is due to the fact that there they were enforced.

Like the rest of the community, the conduct of the professional man was also the subject of legislation. That lawyers were discountenanced and in bad repute in the seventeenth century is rendered evident by the laws of several colonies similar to that passed in Virginia in 1658 against mercenary attorneys, which, after reciting that "the admittance of attorneys and lawyers" had been "to the great prejudice and charge of the inhabitants" of the colony, forbade any person to "give counsel in any case or controversy whatsoever, for any kind of profit or reward whatsoever, either directly or indirectly, upon the penalty of five thousand pounds of tobacco" for each and every breach

* A lecture delivered March 10, 1899, by Herman V. Ames, Ph.D., Instructor in American Constitutional History, of the University of Pennsylvania, at the University College Hall. Revised by the author. All rights reserved.

Neither would the position of a judge have been a very desirable one, or the office much sought for, if the precedent established in the early history of jurisprudence in this colony had long been followed. In the first case in Judge Pennypacker's "Collection of Early Cases in Pennsylvania" (that of Noble vs. Mann, decided in the year 1683), the highest court of the province fined the judge of the county court of Philadelphia (from which court the case came on appeal) forty pounds for having given judgment contrary to the law. Another curious practice, so foreign to modern ideas of judicial procedure, which obtained in several of the colonies during the earlier years, was the custom of allowing the justice to come down from the bench in order to represent a client before the court. Not until 1715 was this practice forbidden by law in North Carolina. The "new woman," especially if she desired to practice medicine, was not encouraged by the Massachusetts authorities; for as early as 1638 we find one Jane Hawkins, wife of Richard Hawkins, was ordered to "depart from the colony within six weeks; and in the meantime she is not to meddle in surgery or phisick, drinks, plaisters, or oyles." In 1648 Margaret Jones, a female doctor, who seems to have offended the other doctors by healing certain patients they had pronounced incurable, was charged with being a witch, condemned, and executed.

Laws regulating courtship, marriage, and the domestic relations were very stringent. We shall only take time to refer to certain peculiar laws in reference to courtship. Within a short period after the first importation of women into the infant colony of Virginia, it was thought necessary to enact the following law against flirts: "Whereas, to the great contempt of the majesty of God and ill example to others, certain women within the colony have, of late, contrary to the laws ecclesiastical of the realm of England, contracted themselves to two several men at one time; and whereby much trouble doth grow between parties; and the governor and council of state much disquieted," it was provided that for the first offense such persons should be published in church; but for the third offense corporal punishment should be inflicted. On the other hand, for the protection of maids nearly all the colonies found it necessary to enact laws similar to that of Massachusetts of the year 1647, which declared that "what person soever from henceforth shall endeavor, directly or indirectly, to draw away the affection of any mayde in this jurisdiction under pretense of marriage, before he hath attained liberty and allowance from her parents or governor," shall forfeit five pounds for the first offense, ten for the second, and for the third he shall be committed to prison, "there to continue until the court shall see cause to release him."

Having seen how the State attempted to regulate the daily life of the individual so as to conserve the common weal, it is next in order to inquire what duties or obligations the individual was required to pay to the State in addition to meeting his taxes and obeying the laws. Here we meet with a principle largely foreign to the ideas of our own day. Office holding and voting seems, in many instances, to have been considered rather an irksome task than a reward or privilege; so that the various colonial governments were compelled to pass laws making such services compulsory. Thus Massachusetts, in 1647, provided that no man should be exempt from service, as constable, selectman, or surveyor on pain of twenty shillings fine; and a few years later it was found necessary to raise the fine to ten pounds for Boston—five pounds for other towns—in order to secure the services of a constable. Plymouth fined all freemen who failed to vote, ten shillings; Maryland, by an eighteenth century law, fixed one hundred pounds of tobacco as the penalty: Virginia passed eight different laws upon the subject, the fines varying from one hundred pounds of tobacco by the first law (1646) to twenty-five per cent. added to their tax bill by the last law of 1788. Some reformers of our own time have advocated the adoption of similar measures as an effective means of bringing out the stay-at-home vote; but no one has found it necessary to suggest artificial means to compel acceptance of political office.

With the development of democracy and the advance of prosperity in the colonies there came a gradual and natural reaction against the extreme paternalistic ideas which required the enactment and enforcement of laws similar in character to these we have just examined. In consequence of this reaction, an exaggerated emphasis was placed upon the importance of the individual, as is seen in the ideas of the equality of man and of the rights of man as set forth in the Declaration of Independence and the Bills of Rights of the Revolutionary period. Man, and not society, became the chief concern: the state was regarded as a necessary evil, whose mission was solely to promote and conserve the interests of the individual; but the reaction went too far to be permanent; so, to-day, we are witnessing a counter reaction against individualism which has misused its freedom. Society, that is, the state, is declaring that it has some rights that the individual is bound to respect; that the rights of the individual and of the few must be made subservient to those of the community. While the indications all point to an increasing sphere of state activity in the future, there is little fear of a return to the paternalism of the olden time.

(To be continued.)

THE TRANSPARENCY OF OPAQUE BODIES.

OUR readers have already heard of the "black light" that was made known by Dr. Gustave Le Bon at the very time that the work of Roentgen began to attract attention in France, and which, according to him, possessed the property of passing through opaque bodies. This invisible light, which is capable of acting upon photographic plates, comprised very diverse radiations, which Le Bon had not had time to dissociate at the moment at which he (for the sake of claims of priority) published a few of the results obtained. His experiments, repeated by several other investigators, were followed by contradictory results, and found their way into works on physics, wherein they were discussed and very diverse interpretations given them.

Dr. Le Bon has continued his investigations, and in some recent notes, published in the Comptes Rendus of the Academy of Sciences, he has given upon the subject of black light, which was at first somewhat confused and contradictory, some very definite data.

He in the first place studied invisible residual light and showed that dark bodies may be photographed in darkness, with the camera, by means of the totally invisible light that they have retained after a short exposure to the sun. He proved experimentally that this invisible light is refracted and polarized, has a spectrum identical with that of solar light, and preserves its photographic properties for more than a year.

This point elucidated, he studied the transparency of opaque bodies in connection with various luminous radiations. In order that the eye may see through an opaque partition, two conditions are evidently requisite: the first of which is that rays shall traverse the partition and the second that the eye shall be sensitive to them.

Through certain artifices, of which he gives the details, Dr. Le Bon succeeded in rendering the photographic plate sensitive to dark radiations. Having then obtained some photographs through opaque bodies, he naturally concluded that luminous rays pass through the latter. But the exposures in this case lasted several hours, and it became necessary to act by contact. The results thus gave rise to all sorts of interpretations.

In pursuing his researches, our experimenter finally discovered a reagent of which the sensitiveness to the invisible rays is five thousand times greater than that of the photographic plate. This result obtained, he was able, in a few seconds, to show the transparency of the most opaque bodies, and render visible an object placed behind a partition or inclosed in a box, and that, too, by taking as a source of light a simple kerosene lamp entirely surrounded with black paper. The sensitive reagent is phosphorescent sulphide of zinc prepared by the Henry method. This is converted into a translucent or opaque screen by mixing it with varnish.*

This screen possesses very curious properties. Presented to the light of day, it becomes illumined; but if certain rays be separated from the visible light by means of proper screens, the invisible rays thus filtered will instantaneously extinguish the phosphorescence, and that, too, proportionally to the thickness or nature of the interposed screens. Now it is these extinguishing rays (of which Dr. Le Bon has determined the wave length through a method that we cannot describe in this place) that possess the property of traversing opaque bodies.

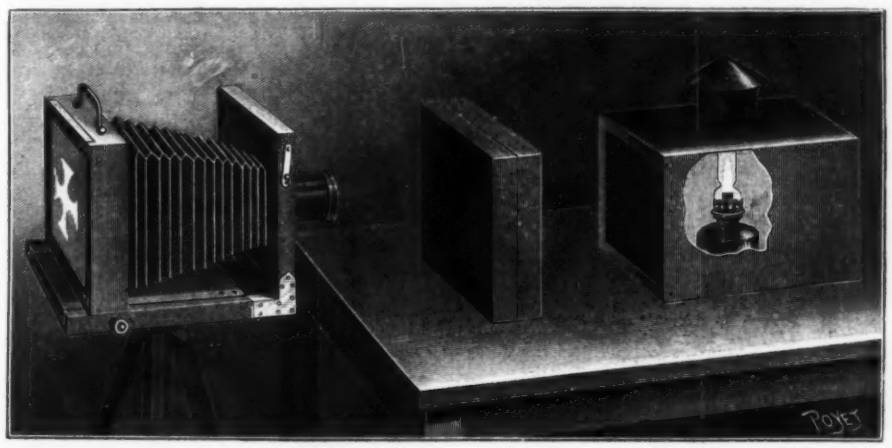


FIG. 1.

Arrangement for photographing through opaque bodies by means of invisible radiations of great wave length. The object to be photographed is placed in a box formed of an opaque material (say black paper, wood, marble, or ebonite). The camera is an ordinary photographic one, of which the ground glass is replaced by a screen of zinc sulphide. The source of invisible light is a kerosene lamp surrounded with black paper. The image is fixed after exposure by applying the sulphide screen against a sensitized plate, which is subsequently developed by the usual method.

The image obtained by interposing the screen between the luminous source and the opaque body lasts but a few instants and is visible in darkness only. In order to render it durable and convert it into an ordinary photographic negative, there is nothing to be done but to place the screen for 30 or 40 seconds against a gelatino-bromide plate, which is afterward developed by the usual methods.

The following is the time necessary to obtain an image through various bodies: ebonite, 1 cm. in thickness, 10 seconds; 4 sheets of superposed black paper, 10 seconds; slabs of marble 2 cm. in thickness, from 5 to 30 seconds; a board ½ cm. in thickness, 60 seconds; 12 sheets of superposed red paper, 70 seconds, etc.

Of all the bodies studied, lampblack alone showed itself to be opaque. Substances that contain any of this, such as black paper and ebonite, become opaque for this reason. It was by taking such opacity of lampblack as a basis that Dr. Le Bon was enabled to photograph through a camera a printing ink design placed in a black paper envelope which was in turn placed in an ebonite box. This photograph formed part of those which he presented to the Academy.

Since the majority of the rays that traverse opaque bodies are invisible ones, it follows that it is possible to eliminate the visible rays from the luminous source, and that, as has already been said, such source may be a kerosene lamp surrounded with black paper. It is in absolute darkness that the observer then sees the object inclosed in the box appear upon the sensitized screen first submitted to a short exposure to daylight and then applied against an opaque box. The boxes that give the quickest results are those of which the bottom and cover have been replaced by black paper, or, better still, by ebonite, such as is employed for rendering a photographic negative brilliant.

One of the photographs published by Dr. Le Bon shows that the spectrum of the radiations that traverse opaque bodies is much more extended than that of the radiations which do not traverse them. According to measurements, it extends, in fact, from 0·7 to 1·5 .

Since the visible rays of the spectrum destroy the action of the invisible ones, Dr. Le Bon concludes that in order to study the physiological action of the latter upon plants and animals, the two orders of radiations would have to be separated.

For the above particulars and the engravings we are indebted to La Nature.

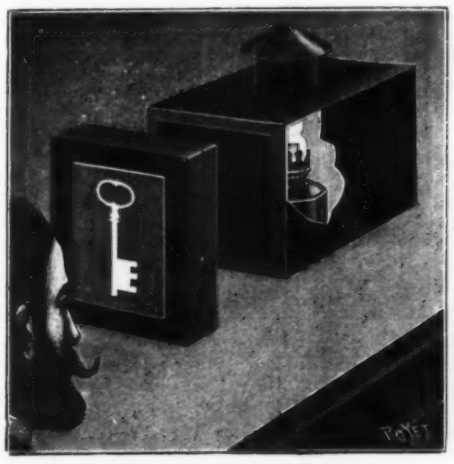


FIG. 2.

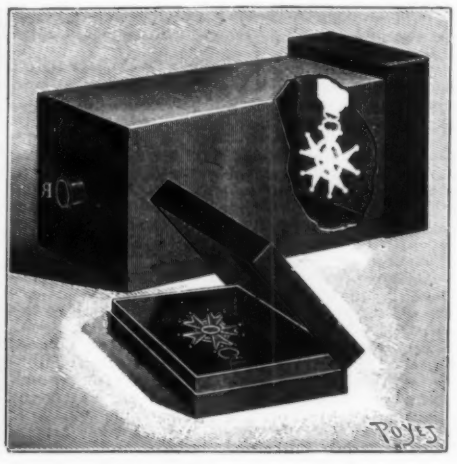


FIG. 3.

FIG. 2.—Vision in an entirely dark camera (and by means of a lamp covered with black paper) of an object inclosed in an opaque box, to the surface of which is applied a luminescent screen sensitized by exposing it to sunlight for a second.
FIG. 3.—Luminescent telescope that permits of seeing an object inclosed in an opaque box or placed behind an opaque partition. The source of the active rays is a kerosene lamp surrounded with black paper.

* This sulphide is found already prepared in commerce. In order to prepare a screen adapted for the experiments, the sulphide is brayed in a mortar, passed through a very fine silk sieve, and the powder intimately mixed with its weight of bronzing varnish. Without allowing it time to settle, the mixture is at once poured over a thin plate of glass to the edges of which has been glued a strip of cardboard 2 or 3 mm. in width and 1 in thickness. In this way there is obtained a translucent screen having the aspect of ground glass. In order to have an opaque screen, cardboard is substituted for the glass.

The telegraphers of Italy are trying to obtain funds to purchase a bronze crown to be placed at the foot of the statue of Volta, in the city of Como, Italy. The crown is to be paid for by popular subscriptions of the telegraphers of the world. There will be a great celebration at Milan and Como in May, 1899, in honor of the hundredth anniversary of Volta's discovery.

THE MINE DEFENSE OF SANTIAGO HARBOR.*

By Lieut. E. E. CAPEHART, United States Navy.

THE entrance to the harbor of Santiago, where ships of any considerable draught can navigate, is scarcely more than one hundred and twenty-five yards wide in its narrowest places, and in order to render it hazardous for our ships to attempt to force a passage, the channel was mined with both electrical and contact mines; the former of the Latimer Clark type, containing two hundred and twenty-six kilos. of guncotton, and the latter, the Bustamente mine, containing forty-five kilos. of guncotton.

The electrical or observation mines were planted in mid-channel, and were controlled, at first, by two stations on the west or Socapa bank, one on Cay Smith and one at Estrella Cove on the east bank. The station at Estrella Cove and the inner one on the Socapa bank were in the best possible positions for protection, and could have been operated even should the banks have been swept by the guns of our fleet. In the cove just behind the Morro the operator could, in almost perfect security, observe his mine field until the ships to be destroyed were almost abeam of him, and could operate his mines long before he could be discovered.

At the inner Socapa station the same condition of affairs existed, as the station was in behind the hill and close down near the water. Cay Smith and Outer Socapa were not so well protected, but were still commanding positions.

The length of channel controlled by these mines reached from the entrance, just off the Morro, up to about midway between Puntilla and Soldados points.

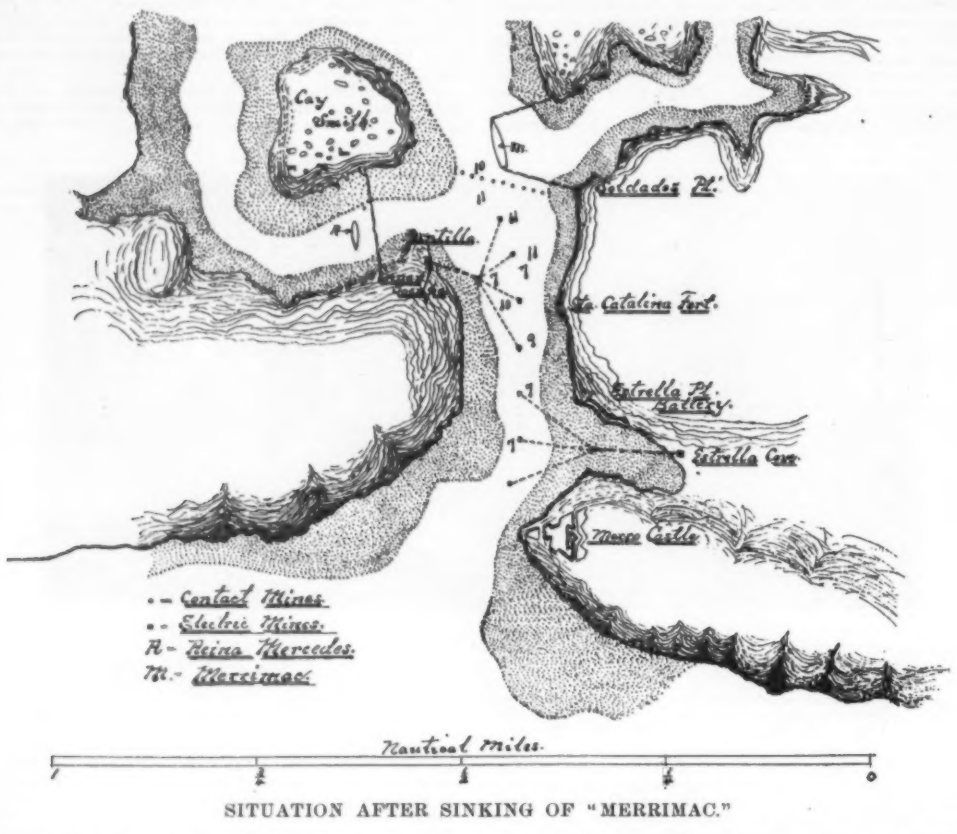
From Cay Smith across the channel, running in about an east-southeasterly direction, a line of nine Bustamente or contact mines had been planted also, so that any ship attempting to enter the harbor would, of necessity, be compelled to pass over from eight to ten electrical mines, and then across a line of contact mines planted so closely together that she must, if of any considerable beam, surely strike one, and possibly two of them in passing.

The electrical mines were planted on the bottom in from seven to eleven fathoms of water, and the contact mines anchored to float at about eleven feet under the surface.

An effort was made to fire the five electrical mines controlled by the station at Estrella Cove when Hobson made his gallant but unsuccessful attempt to block the channel with the "Merrimac," but only two of the five detonated. Further in another mine was fired from the Inner Socapa station, and Hobson reports that it lifted the "Merrimac" some and probably aided to sink her, as she went down a short distance further in.

After she was sunk the defense of the channel was as follows: A line of three doubtful electrical mines controlled by the Estrella Cove station, four other electrical mines running from a point just off Santa Catalina Fort up the channel, and the nine contact mines before mentioned as running from Cay Smith across to the eastern bank; these last running just under the stern of the "Merrimac." In addition to the mines the channel was blocked by two log booms running from the bow and the stern of the "Merrimac" over to the eastern bank, the logs being secured to each other by five-inch steel hawsers. A similar log boom was also stretched from Puntilla across to Cay Smith. (See chart.)

The control stations for the electrical mines were small wooden huts covered with branches of trees, and absolutely concealed except for a small slit about four inches deep, and just long enough to take in the two ends of the mine field to be operated. These stations contained the most elaborate electrical appliances for testing the circuits and for firing. A large table with testing battery, Wheatstone bridge, and galvanometer was found in each, together with a firing battery, sighting quadrant, and numerous books giving full descriptions of the ships of our navy, with photographs accompanying. All stations were in telephonic communication with each other. After the surrender it was discovered that, on account of the failure of the three mines controlled by the Estrella Cove station, that station was abandoned. Only parts of the testing and firing mechanism were found there, other parts having been destroyed or carried off. The stations on Cay Smith and Outer Socapa were also abandoned, as the inside station on the Socapa side was considered to be so advantageously located that it, alone, was considered sufficient to control the remaining mines.



SITUATION AFTER SINKING OF "MERRIMAC."

SIGHTING QUADRANT.

The means of determining the proper moment to fire the electrical mines were a sighting bar in connection with a quadrant of a circle, having on it as many contact points as there were mines in the mine field. The sighting bar was pivoted at the center of the circle from which the arc was described, and could be swung around so that its front end could be brought in contact with any one of the contact points on the arc.

The whole arrangement was evidently installed in the control station, and the mines planted on the ranges indicated by the line of sight as given by the bar in its various positions, that is, with its front end on the different contact points of the arc.

The main cable was made up of a number of small well insulated cables, all bound together and covered with jute braiding for the distance from the control station out to the junction box, and where this cable came into the control station it was made fast, and the separate parts of it were each led to one of the contact points on the arc of the sighting quadrant. These wires and the contact points were numbered with the same numbers that had been assigned to the mines as they were planted.

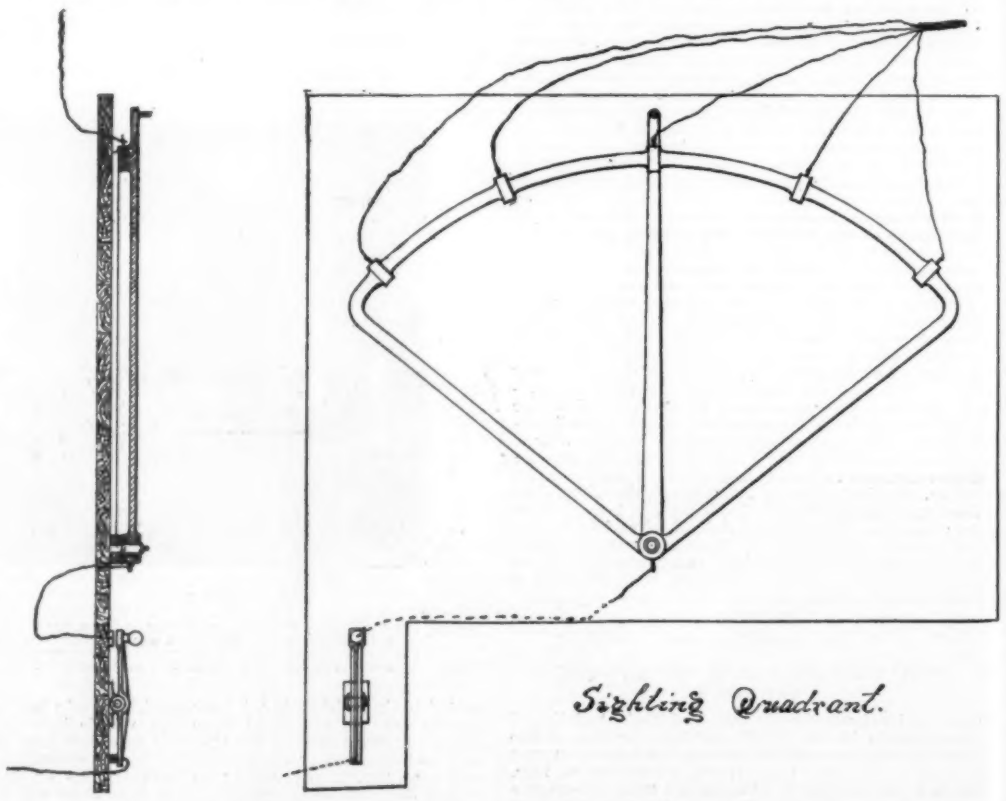
Outside of the control station the cable ran out into the water for about one hundred and fifty yards, where it led into a junction box, from which branch leads radiated to each of the mines planted. The mine connection of each of these branches was as follows: In the top of the mine was a watertight stuffing box, through which the leading wire entered and made fast to one pole of the detonator, the other pole being made fast to the metal of the stuffing box outside the mine. At the shore end of the cable one pole of the firing battery was placed in contact with the earth and the other connected to the sighting bar, the firing key making a break between the two.

To test any particular mine, place the front end of the sighting bar on the contact point of the arc corresponding to that mine, and with the testing key and testing battery, in connection with the Wheatstone bridge and galvanometer, the good or bad qualities of the circuit were established. The arrangement was very simple and at the same time very complete.

To fire a mine under a vessel attempting to run the channel, connect with the firing battery, take the guard off the firing key, and, when the vessel comes on your line of sight, as indicated by the front and rear sights of the bar, press the key.

In order to make the entrance of the harbor safe for the passage of our ships, the commander-in-chief, on July 17, sent a working party in to destroy the electrical mines, and raise the contact mines. Of the four presumably good electrical mines off Inner Socapa, two failed to show continuity of circuit, and, after repeated attempts to detect their faults and to fire them, their positions were located and they were noted "to be raised." The other two were successfully fired, but the column of water thrown up by each was surprisingly small. This may be accounted for, in part, by the great depth in which they were planted.

The two noted "to be raised" were recovered in the following manner without any accident whatever: The "Suwanee," under the command of Lieutenant-Commander Delehanty, was sent in to assist in recovering these mines, as she was fitted with just the sort of anchor gear that was necessary to use in lifting them, and after the chain sling of the mine was once secured, she simply hooked her fish fall in the ring in the end of it, and with her steam winch hoisted the mine up clear of the water. All connections at the control station were broken, simply as a matter of ordinary precaution; the main cable was underrun by a dinghy for about one hundred and fifty yards, where a junction box was found. By means of a wrench the nuts holding the top on it were taken off, and the box was found to contain a branch lead from the main for each mine planted, each lead having a tag on it corresponding to its number on the contact point on the sighting quadrant. Knowing the numbers of the two mines fired, it was an easy matter take each of the other two in turn and, leaving the junction box in a boat, underrun its cable until the end of a small chain was found stopped to it at intervals. This chain had a ring in its end, and, after casting it adrift from the cable, the boat was hauled over until it led up and down. The "Suwanee" then steamed up and hooked her fish fall in the ring in the end of the chain, hove the mine up above the water, and a steam launch went alongside and received it. A short chain sling led from each corner of the mine to a ring in the center, and to this ring the hoisting chain made fast. A vessel like the "Suwanee," or a large



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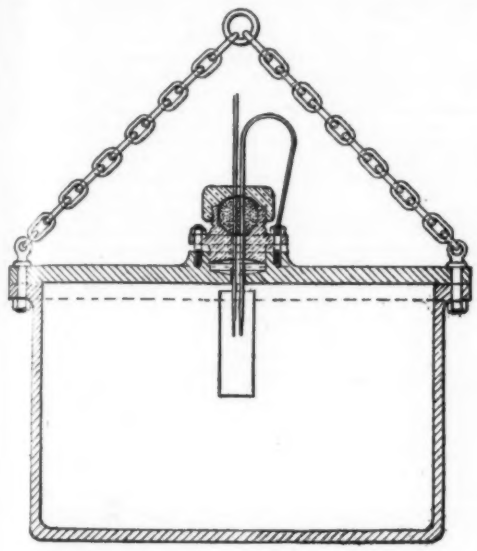
launch or tug with good tackles, is absolutely necessary in raising these mines, as they weigh close onto a ton and, if the bottom is soft, sink into the mud for a considerable distance.

The mines recovered were of the following general description: The case was of cast iron, about three-quarters of an inch thick, the top and body being cast separately, and, after the charge of guncotton had been placed inside, these were securely bolted together, with a rubber washer between them. The whole thing was in the form of an iron box about thirty-six inches on a side and about twenty inches deep, and, as stated before, the leading wire entered through a central watertight stuffing box. The detonating agents were two fulminate of mercury detonators, each containing about seventy grains, as well as could be judged, connected in parallel and embedded in the heart of the dry guncotton primer.

To prevent injury to the connections, from pulls or sudden jerks on the leading wire, a cuckold's neck was



Observation Mine.

turned in it, and made fast to a ring on one of the corners of the mine. As soon as the mine was in the launch, the stuffing box was taken off to permit of an examination being made, and this should always be done if recovering a mine that has failed to fire. If the detonators have fired, well and good; if not, then remove them from the mine at once as a matter of precaution.

The remaining mine off Inner Socapa and those off the Estrella station were recovered in the same general way by the "Suwanee."

CONTACT MINES.

The line of contact mines, running from Cay Smith across to the eastern bank, passed just under the stern of the "Merrimac" and completely blocked the channel; but on the afternoon of July the second four of these mines were taken up between Cay Smith and the "Merrimac," and on the morning of July third the connections at Inner Socapa were temporarily broken, so that the Spanish fleet passed out in perfect safety. After they had passed the mine fields the connections were immediately made again, and the four contact mines planted in their original places. (Chart.)

The operation of recovering these contact mines will probably be better understood after a brief explanation of the method of planting them, and a description of the different parts has been given. The description, as here given, is of the mine as it was found at Santiago, and may not be exactly technically correct according to the ideas of the inventor, but is correct regarding those recovered. The mine is in the shape of a conical buoy thirty-two inches in diameter at the top and twelve and one-half at the bottom, and stands thirty-six inches high. It has a central axial hole in it eleven and three-quarters inches in diameter for the entrance of a cylinder containing the charge of wet guncotton. The bottom of this hole is closed by an iron plate, and on the outside of this plate is secured the frame of a reel which carries about twenty fathoms of wire rope for anchoring the mine. On the barrel of the reel is a toothed wheel, against which a pawl is held by a spring, preventing rotation until the pawl is raised.

On each end of the barrel, outside the frame, is a two-bladed fan, the area of each blade being about sixty square inches. When the pawl is lifted, by a rod running up alongside the mine, it releases the reel and allows the wire to unwind, and by letting go this rod the spring holds the pawl hard against the toothed wheel and stops the revolution of the reel. The fans are to prevent a too rapid revolution of the reel and a consequent snarling of the anchor wire.

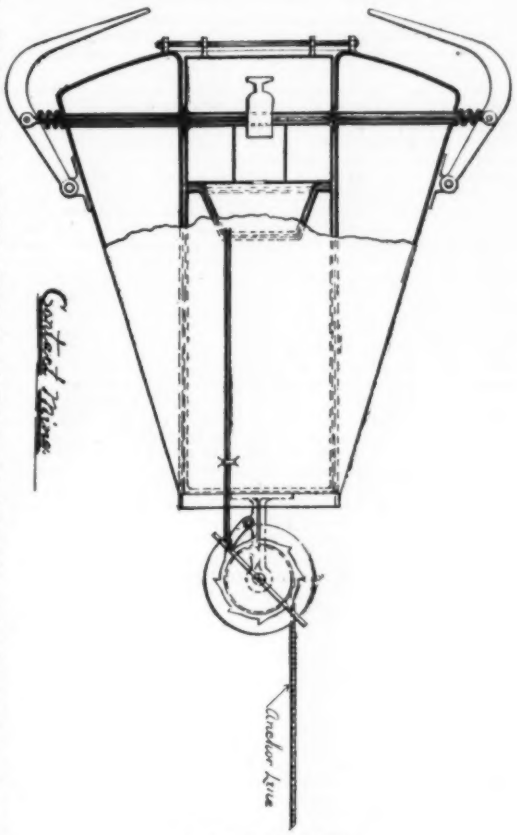
The cylinder which fits in the central hole in the mine contains forty-five kilos. of guncotton, and is secured to the bottom plate by four bolts and nuts, but does not reach to the top of the mine by about eight inches.

In the upper end of the cylinder is a conical hole for the reception of a vessel containing the dry primer of guncotton. This vessel containing the dry primer is secured against a rubber washer on the bottom of a small hollow cylindrical buoy, which fits in the upper end of the same axial hole as the large cylinder containing the wet charge. Inside of the small hollow cylinder are six plungers, spaced at equal distances around the circumference, and converging to the center, where their inner ends rest on a glass tube filled with sulphuric acid; their outer ends being in contact with plungers operated by contact arms on the outside of the mine. The hole in the small buoy where the outer ends of the plungers make contact with those operated by the contact arms is covered with thin sheet lead to make the buoy watertight, the blow from the contact arm being sufficient to rupture this lead when the mine is struck by a passing vessel.

Around the tube of sulphuric acid is a composition of chlorate of potash and sugar, and a central hole gives communication between this composition and the dry guncotton in the conical vessel attached. To the eye, the only substances that could be absolutely determined were the chlorate of potash and the sugar, but this alone will not make, with sulphuric acid, a detonator. Therefore, there must have been some fulminate in combination with these two substances, or in the heart of the dry primer of guncotton, to produce a detonating effect. I quote from an opinion of the chemist at the United States Torpedo Station, Prof. H. F. Brown. "The reaction of sulphuric acid, potassium chlorate, and sugar will evolve a large amount of heat and will probably result in an explosion. This explosion will ignite dry guncotton, which, consequently, will produce an explosive effect. It is my opinion that this explosion will not be a true detonation unless there intervenes some fulminate of mercury or other substance whose ignition, like that of the fulminate, amounts practically to a detonation. I should not expect the explosion of a mass of wet guncotton which might be adjacent to the dry primer (of guncotton)." This opinion is fully substantiated by other authorities, and, therefore, although no fulminate appeared to the eye of the observer, it must have been there, or the mine would have been valueless. The detonating agent is, therefore, the material in the buoy and the dry guncotton primer.

In planting the mines the buoy and dry primer attached are placed in position in the upper end, as a last preparation, and a small rod is run across the top of the mine through lugs, to hold it in place. To one end of this rod a line is made fast, and to the end of the line a small wooden buoy is secured, intended to act as a signal buoy, the length of the line being so judged that the buoy will float a short distance under the water when the mine is planted. The buoy carrying the dry primer has a ring in its top to which a line, from the upper end of the rod operating the pawl on the reel for the anchor wire, is made fast.

The depth of water is known, as is also the depth below the surface it is intended the mine shall float. Having the mine slung, pull up on the rod operating the pawl on the reel and allow the wire to run out to the depth of water, minus the depth below the surface the mine is to float; let go the rod and lower away gently on all. The mine is pulled down under the water and floats at the depth determined upon, while the small wooden buoy, acting as a locating buoy, floats about one foot under the surface. (Sketch.)

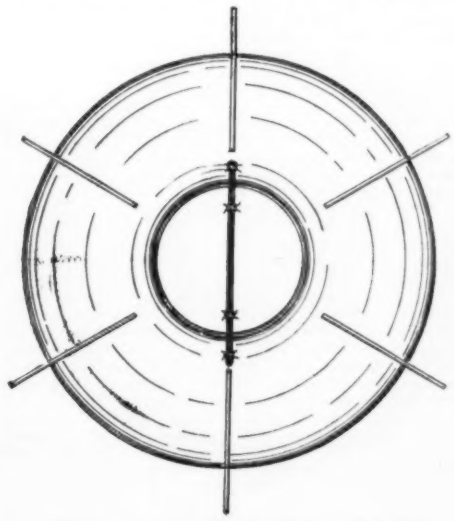


CONTACT MINE.

The location of the line of contact mines was known, approximately, before the surrender, and this knowledge was verified by the commanding officer of the Spanish gunboat "Alvarado" captured in the harbor. A small boat was used in raising the mines, and the work was carried on in the early morning on account of the light and smoothness of the water, which became rough later on in the forenoon and made it difficult to locate the signal buoys. Once on the range, the boat was pulled slowly, with a number of watchers on each side. As soon as one of the small wooden buoys was sighted it was secured, and by pulling on the line steadily the pin running across the top of the mine, holding the cylindrical buoy, with dry primer attached, came out, allowing the latter to rise to the surface quickly. Attached to the ring in the top of the cylindrical buoy is a line which has its lower end made fast to the rod operating the pawl on the reel for the anchor wire. Pull up on this line, lift the pawl, and allow the wire to unreel until the mine comes to the surface.

Lift the cylindrical buoy, with dry primer attached,

CONTACT MINES AND CABLE REELS.



PLAN OF TOP OF CONTACT MINE.

in the boat, and you have nothing to deal with in the mine but a charge of forty-five kilos. of wet guncotton. By pulling up on the rod operating the pawl of the reel, and reaching down with a boat hook, the bight of the anchor wire was secured and the anchor weighed. A line was then made fast to the mine and it was towed ashore and hauled up on the beach. The work of re-

covering eight of these mines required less than a day. This method of recovering contact mines presumes, in the beginning, that their location is fairly well known, as, otherwise, the plan of sweeping for them with two boats must be carried out, as was done by the "Marblehead" and "Dolphin" at Guantanamo.

The work of sweeping for the mines at Guantanamo was done at a time when those engaged in it were likely to be subjected to the fire of Spanish riflemen in pits on the left bank of the channel leading up to Caimanera. These pits were covered by the guns of the two ships whose boats were engaged, while the pulling boats, in tow of the steam launches, also contained riflemen. The general plan was to sweep with the chain and line between the boats as indicated in the sketch, and when a mine was secured, place wedges between the body of the mine and the contact arms, as a precautionary measure, until the dry primer could be taken out.

Before leaving the subject of contact mines I wish to say that I discovered an appendage to some of those recovered which I was at a loss to understand. This was a small cylindrical buoy, about five inches high and about eighteen inches in diameter, and was attached by a line to the rod operating the pawl of the reel for the anchor wire. It apparently had been intended to act as a buoy in the original design, but, as found at Santiago, there were holes punched in its sides, as though by a nail, and the result was that instead of acting as a buoy, it had an appreciable weight to it and pulled down on the rod to which it was attached, thus assisting the spring to hold the pawl on the toothed wheel. On some of the mines this was missing, and its office on those where it was found seemed to be of very little importance.

During the latter part of June a plan for countermining the channel leading into Santiago was developed and approved by the commander-in-chief; the officers who had volunteered to carry out the scheme reporting everything ready on the first of July.

The destruction of the fleet, the surrender of the Spanish army, and other incidents made it unnecessary to carry out the plan as developed, but it is simply noted here that the plan was after the accepted ideas of all nations, that is, to explode simultaneously a number of heavy mines, containing about five hundred pounds of guncotton, in the mine field. These mines were to have been dropped in succession from a boat, towed by a fast launch or steamer, and the whole exploded as the last mine reached the bottom. The explosion of a countermine of five hundred pounds of guncotton will destroy all mines within a radius of from two to three hundred feet, and the practical application of the proposed plan had every chance of success.

The mine fields were well protected by many rapid-fire and machine guns secreted on the Socapa side of the entrance; the guns and carriages being painted the same color as the earth, and almost entirely covered with brush. Between Puntilla and Cay Smith the "Reina Mercedes" lay in the cove, protecting the line of contact mines, while Punta Gorda battery could fire straight down the harbor. Added to this, the brush on each side of the entrance was thick with concealed riflemen.

Nature had done everything to assist in the protection of the channel, the electrical mines were of the most approved type, and the contact mines, if properly attended to, were dangerous to an enemy. But the very best of tools, if placed in the hands of inexperienced or indifferent workmen, will seldom give good results.

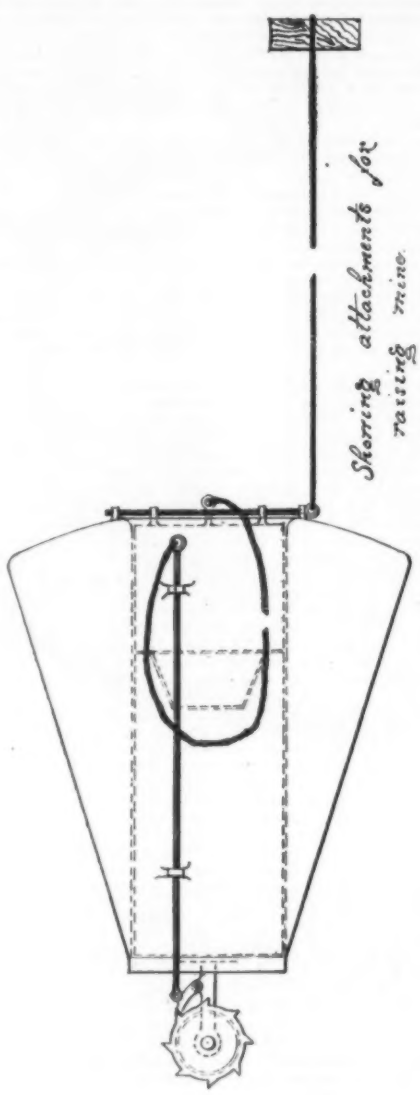
The mines in the entrance were said to have been planted by the officers of Admiral Cervera's fleet, and there were many evidences of the hurry with which they were put down. Lieutenant-Commander Delehanty, who commanded the "Suwanee," and who lifted the observation mines with his ship, says: "None of the mines were recovered intact. The connections were, as a rule, broken, the dry primers drowned out, or the mines partially exploded."

In many places the coverings of the branch cables were chafed off, and some of the strands of the wire bare; the result, no doubt, of paying the cable over the gunwale of the boat used in planting the mines.

The maxim that "insulation is for the purpose of making electricity go where we want it to go," had evidently never occurred to the officers engaged.

In one electrical mine recovered there was evidence of a partial explosion, which did not show at the surface of the water. The bottom of the mine was partially blown away, leaving about one-half of it intact, and inside the mine was a large quantity of wet guncotton, which rolled out of the hole in the bottom as the mine was lifted and lowered into the launch alongside of the "Suwanee."

In firing exercise spar torpedoes at the torpedo station, the writer has seen it frequently happen that a leak in the top of the case would admit enough water to prevent a detonation, but the case would be ruptured and the torpedo, on recovery, would show that the detonator had gone off, but that the dry primer had become damp or wet. A careful examination of the



mines recovered seems to indicate that one of the small and almost insignificant points connected with the preparation of mines had been entirely ignored. I refer to the method of securing the stuffing box to the top of the mine. The fact that so many mines had the dry primers drowned out, together with the appearance of the stuffing box, proved that, instead of screwing down gradually on the nuts, securing the stuffing box to the mine, so that the flange would take equally all around, one side was screwed down tight, and then an attempt was made to screw down the other side. Experience proves that this is not always possible, and I believe that this accounts in a great measure for the failure of most of the mines.

Another point was that the mines seemed to be placed too close to each other. Taking the length of channel to be guarded, and considering the fact that five hundred pound mines may be destroyed, if within three hundred feet of each other, it appears that these were too close, and the detonation of any one of them would, if it did not detonate the others next to it, at least destroy their electrical connections and render them absolutely useless. This did happen at Estrella, and I believe also at Inner Socapa. The mines that were fired at the "Merrimac" utterly destroyed the connections of the three that were left at Estrella.

To get the full effect of a mine a ship must naturally be over it, but this can seldom be brought about unless two control stations are occupied. After the "Merrimac" sank, all but one of the stations at Santiago were abandoned, and therefore it would have been a stroke of extremely good fortune had a mine been detonated at the exact moment when a ship was over it. Experiments have, however, been made to determine the horizontal distance at which an armored vessel would be vitally injured by different charges of guncotton in mines, the following being the results:

Mine.	Submergence.	Dist. horizontally.
150 pounds	10 to 15 feet	4 feet
250 "	30 "	10 "
500 "	60 "	15 "

This last corresponds nearly with the conditions existing at Santiago, but with the faults in the circuits, and the other attending difficulties, it is scarcely likely that these figures would have been reached.

CONCLUSION.

Contact mines of the type encountered at Santiago and Caimanera are liable, from the growth of barnacles, to become very much impaired as regards the operation of their different parts, especially the contact arms. This growth forms so rapidly in the warm water of the tropics that in a very short space of time it is sufficient to prevent the arms from driving the plungers in far enough to break the vial containing the sulphuric acid. They therefore require constant attention, and from observation it seems that, to make them effective, they should be raised and cleaned about once in three weeks. The examples of the "Texas" and "Marblehead" picking up on their screws mines of this description are sufficient to illustrate the harmless condition to which they may revert, no matter how good they may be when planted.

Had due care been exercised in planting the electrical mines, and a fair amount of attention paid to the contact mines in Santiago Harbor, no ship could have passed the two fields. But the well known character of the people who planted and attempted to operate them accounts, in a great measure, for the condition in which they were found.

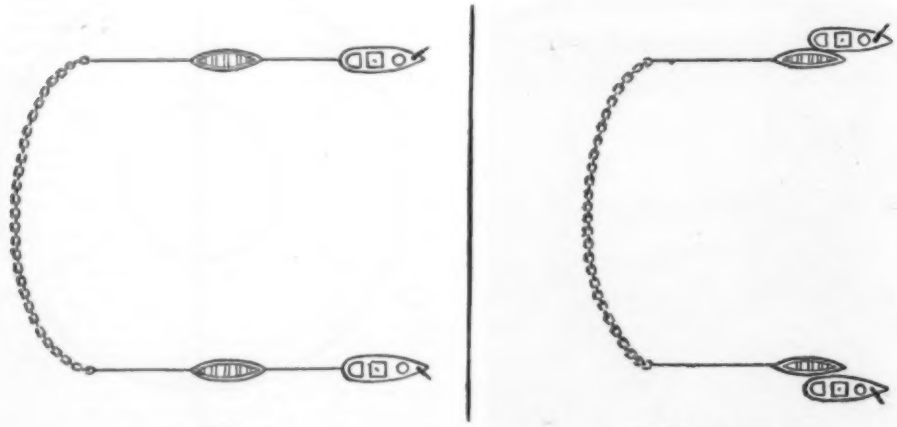
The moral effect of a mined harbor is tremendous, and the question of risking valuable ships is of vital importance. What would have happened to a ship attempting to run the mine field is problematical, but the chances were that she would have been sunk, for notwithstanding the number of bad mines encountered, enough good ones were left to destroy her.

The electrical mine was perfect in type and design, and had it been properly planted and cared for, the protection given by it to the entrance would have been absolute.

The lesson to be learned is evident: Mines cannot be planted hurriedly and carelessly, allowed to remain without attention, and then be expected to give theoretical results.

Officers of Admiral Cervera's fleet stood watch in the control stations at Santiago, and must, naturally, have been alert and attentive to their duties, so that in considering the matter from all sides the facts which come home to us are these: The theoretical knowledge of those who selected the firing stations, planted the mines, and weighed the question of properly defending the channel was fairly perfect, but in the vital point of a practical knowledge of how to prepare and plant these mines they were deficient.

It does not require much of an argument to convince us all that practical education in this particular branch of our profession is what the service needs. The details, at times so seemingly insignificant and unimportant, are just the trifles which make success or dismal failure. In a mine defense one cannot admit, for an instant, that there is a chance of failure, for it must be so perfectly installed that it may be counted upon with perfect confidence. This is feasible and possible, and a course of training would, in a short time, make the members of our service masters of the important details, without which knowledge no assured success can be expected in either mine defense or countermining.



FIRST METHOD. SECOND METHOD.

METHODS OF DRAGGING FOR SUBMARINE MINES IN CHANNEL BETWEEN PLAYA DEL ESTE AND CAIMANERA.

While the proposed penny-in-the-slot hot-water machines for lamp posts are attracting the attention of London people, it is interesting to note the results already observable in the houses of the poor people of that city whose gas is being supplied on the same principle. The South Metropolitan Gas Company has placed a gas stove, fittings, and a coin meter in the homes of working people who were too poor to pay for them. The outlay amounts to $30 per house. To cover this the company charges 20 cents extra per 1,000 feet of gas. That is, while ordinary consumers pay 55 cents, those who have coin meters are charged 75 cents per 1,000. There are 84,000 ordinary consumers, and the coin meter consumers already number 61,000. The average receipts from each of the latter are $15 per year. From 200 to 300 coin meters are now being put in each week, and in a short time the company's receipts from this source will equal $1,000,000 annually. Between twelve and two o'clock on Sundays, while dinner is being cooked, it is a problem to get sufficient gas through the mains to supply the demand. A pennyworth of gas will light a room from five to ten-thirty o'clock. In the cold weather the very poor put their last penny in the slot to obtain a little warmth, and doubtless many unfortunates have been kept from freezing by this means.

The Director of the observatory at Sydney, N. S. W., Prof. H. C. Russell, has recently paid considerable attention to tidal waves. He finds that these undulations of the sea are of the same period as waves due to earthquakes, that is to say, about twenty-six minutes from crest to crest; but he says it has been proved that only one per cent of them are due to terrestrial commotions, and sixty per cent of the waves which trouble the territory with which he concerns himself originate in Bass Strait, where the meteorological conditions that accompany a center of low pressure show themselves in that part of Australia. The effect of a low pressure area is to cause an elevation of the sea level which brings about currents along the south and east coast of Australia.

THE ZICKLER SYSTEM OF ELECTRO-OPTICAL TELEGRAPHY.

THE principal fault to be found with the Marconi system of wireless telegraphy is that it does not assure secrecy in the correspondence transmitted, since the signals can be read by any one who has an appropriate receiver at his disposal. The system of Prof. Zickler, of Brunn (Moravia), on the contrary affords much ampler security; and, as will be seen, from the description given below, it would be very difficult to read surreptitiously the signals exchanged by the correspondents who are using it.

The principle upon which it is based is the property possessed by luminous rays of short wave length (particularly the ultra-violet ones) of favoring or causing electric discharges. If, for example, we separate the poles of a Ruhmkorff coil in action until the difference of potential is no longer sufficient to cause a spark to continue to be produced between them, and the ultra-violet rays then chance to strike these poles, the spark will be immediately re-established. Prof. Zickler puts this phenomenon to profit in the following manner. From the transmitting station, he sends the ultra-violet rays of an electric arc in the direction of the receiving station. At the last named station, these rays cause the formation of sparks, which produce electric waves that act upon a "coherer" in such a way as to actuate a Morse apparatus.

As in the Marconi system, the spark here plays the chief role; but, instead of being produced at the transmitting station, it bursts forth and produces its effect at the receiving one.

The transmitting apparatus (Fig. 1) consists of an electric arc, *L*, inclosed in a box movable in all planes,

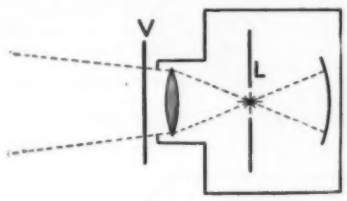


FIG. 1.

like that of a projector. The lenses must be of quartz crystal, so that the ultra-violet rays shall not be intercepted. In front of the aperture there is a screen, *V*, of ordinary glass, which is actuated automatically after the manner of the shutter of a photographic camera.

As soon as the arc is established, the luminous pencil is projected through the aperture. Its brilliancy is in no wise altered by the glass screen, since the latter allows the visible rays to pass; but, inasmuch as ordinary glass absorbs the ultra-violet rays, no electro-luminous effect can be produced at the receiving station. These rays can pass only when the glass screen, *V*, exposes the aperture; and it is then that the action intervenes at the other station. When the screen is opened and closed at proper intervals, there pass ultra-violet rays that correspond to the dots and dashes of the Morse alphabet. During the operation, the ultra-violet rays are the only ones shut off; the visible rays passing without interruption.

An observer of the luminous pencil can therefore read no signal, since the pencil undergoes no alteration that is capable of being perceived by the eye.

Fig. 2 represents the receiving arrangement. The

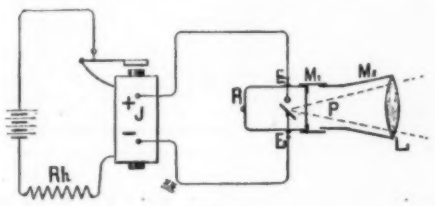


FIG. 2.

receiver itself (Fig. 3) consists of a very small glass cylinder, *R*, of which the opening in front is closed by two parallel plates of quartz, *P*, hermetically sealed in the glass. In this cylinder there are likewise sealed two electrodes, E^1 and E^2, one of which, E^1, is a sphere of a few millimeters diameter, and the other, E^2, a disk placed in such a manner that it may be struck by the luminous rays entering through the quartz window, *P*.

The two electrodes are covered with platinum foil in order to prevent oxidation, which would destroy them. They are separated by an interval of about 10 mm. A vacuum of a proper degree is formed in the cylinder, *R*, or else the latter is filled with a tenuous gas.

Fixed to the front part of the glass cylinder there is a metallic tube, M^1, which carries an extension in the form of a funnel, M^2, closed by a quartz lens, L^1. As this extension slides in the tube, M^1, it may be regulated (that is to say, shoved in or out) by means of a

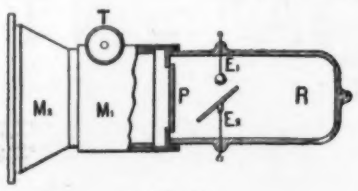


FIG. 3.

milled headed screw, *T*, so as to bring the focus of the lens, L^1, upon the electrodes. A portion of the luminous pencil may thus be directed to and concentrated at the proper point. A parabolic mirror might be substituted for the quartz lens.

The secondary wire of a small induction coil, *J* (Fig. 2), is connected, on the one hand, with the electrode, E^1, and, on the other, with the electrode, E^2, in such a way that the spherical electrode shall be the anode and the plane one the cathode. There is no need of the induction coil having a power greater than that necessary to obtain a spark of from 1 to 2 centimeters in length. In its primary circuit there is interposed a rheostat, *Rh*, that permits of gradually varying the intensity of the induction current.

In order to put himself in a position for obtaining signals, the person at the receiving station must first so place himself that the axis of his apparatus shall coincide with that of the luminous pencil of the correspondent that he faces. He afterward actuates his induction coil and regulates his rheostat until the tension has reached the normal point, that is to say, the exact limit at which the sparks cease to pass between the electrodes. On another hand, he regulates the length of the tube that carries the quartz lens, L^1, in such a way that the latter shall project the concentrated rays of the correspondent upon the electrodes, E^1 and E^2. This being done, as soon as the correspondent displaces the glass screen, *V*, of his transmitting apparatus, the ultra-violet rays will pass and strike the electrodes of the receiving apparatus, and a spark will make its appearance between them. As soon as these rays are interrupted again, the spark will disappear.

It will be easily seen from this that the effect produced by the maneuvering of the glass screen, *V*, of the transmitting station is the formation of signals at the receiving one. The electric waves resulting from the sparks influence the coherer, and the signals are received as in the Marconi system. For a practiced eye there is no need of either a coherer or of any accessory apparatus in circuit with it. The light of the spark suffices to permit of the reading.

The experiments performed by Prof. Zickler have likewise demonstrated that the passage of the sparks in the secondary circuit of the coil suffices to actuate directly a relay of special construction, a call bell, a sounder, and a printing apparatus, and that a telephone might likewise be used as an acoustic receiver, as the signals are audible at a distance of a meter.

The distance to which it has been possible to transmit signals is, up to the present, but 1·5 kilometers (about a mile), but the inventor hopes, through methods at his disposal, to increase such distance and give his system a power that will render it truly practical. It might easily be adapted to ordinary projectors, without any essential modification of such apparatus.

For the above particulars and the illustrations we are indebted to L'Electricien.

MOSQUITOES AND MALARIA.

By PERCY H. GRIMSHAW, F.E.S., Natural History Department, Edinburgh Museum of Science and Art.

FOR some time past mosquitoes have been accused of taking an important part in the dissemination of certain diseases. This accusation was justified some years ago by the researches of medical men into the nature of the disease produced by a parasitic worm known as the filaria, or thread-worm, various species of which are found beneath the human skin, and which are quite common in hot countries. The mosquitoes, in sucking the blood of an infected person, are supposed to imbibe the parasites into their own system, and then by dying, or in other ways, to contaminate water, which may be afterward drunk by some other person, to whom the disease is thus communicated. Quite recently, however, successful attempts have been made to connect the "bite" of a mosquito directly with the production of various forms of malaria, or malarial fever, as it should more strictly be called. It seems that the medical experts in London are now accepting the conclusions of Prof. Grassi, of Rome, as to the cause of black-water fever, which is one of the worst forms of malarial fever, and the scientific staff of the Natural History Museum, at South Kensington, are inviting travelers in all countries to collect as many mosquitoes as possible in the districts visited by them, with a view to properly identifying the various species, and tracing out still further the supposed connection between these insects and some of the fevers prevalent in tropical climes.

In the transactions of the society known as the "Reale Accademia dei Lincei," published at Rome during the last three months of 1898, Profs. Grassi and Bignami have given a most interesting account of their experiments and conclusions. As their communications are in the Italian language, and not generally accessible, it may be useful to give here a short résumé of their researches. In order to thoroughly understand the subject, however, my readers must have a proper idea of the insects concerned, and also of the nature of their so-called "bite."

The name "mosquito" has from time to time been applied to almost any small insect which sucks blood, but, properly speaking, it only refers to members of one group or family of two-winged flies, that which contains the true gnats. The latter name can therefore be applied with absolute accuracy to mosquitoes. In this country we have about twenty different species of gnat, in Europe there are about fifty, and in the world generally over one hundred and fifty. No doubt, with the increased attention which will now be paid to this family of insects, many more species will be discovered, although most people will be of the opinion that we have a sufficient number already! As I cannot describe all the species without devoting a small volume to them, and as they are all closely related to one another in structure and habits, it must suffice to say a few words about the best-known species, that bearing the name of Culex pipiens. This is structurally a very beautiful insect, about half an inch in length, which announces its presence by the peculiar "piping" sound to which it owes the second part of its scientific name. It has only a single pair of wings, thus proclaiming itself a true dipterous or "two-winged" fly, six long, slender legs, a pair of feelers or antennæ, and a proboscis which does all the harm. The antennæ differ greatly in the two sexes, for while in the male they take the form of a pair of beautiful feathery plumes, in the female they consist of a simple series of joints each bearing a ring of short hairs. The sexes also differ materially in the structure of their mouth-parts, and it is important to note that only the female "bites" or rather "punctures." The male is quite harmless, owing to the deficient nature of its mouth-organs, and it is only necessary, therefore, to describe the proboscis of the gentler (?) sex.

Briefly, the proboscis of the mosquito consists of a tube, or rather trough, within which are concealed no less than six bristle-like boring implements, two of which are somewhat broadened and sharpened at the tip to form a pair of small lancets, and other two barbed or serrated, so as to form most effective saws. When the insect begins its work, it fastens the end of the trough firmly down against the flesh of its victim. Then it places the bristles close together so as to form a solid boring instrument, which it plunges into the flesh, and then sucks up the blood through the tube which is formed by the union of the bristles with the trough.

Now, as mosquitoes are almost invariably found in damp or marshy places, it is not surprising to learn that the early stages of their life-history are aquatic. The female insect lays about a couple of hundred eggs in a tiny boat-shaped mass, which floats like a raft upon the surface of ponds and stagnant water of all kinds. The eggs soon hatch and produce grubs which live entirely in the water, moving actively about by means of a series of curious jerks, and occasionally coming to the surface to breathe. This grub, which, by the way, differs from its parents in possessing a pair of true biting jaws and no sucking apparatus, soon transforms itself into an odd-looking creature, which never takes food at all, for the reason that it has no mouth. When the time comes for further change, the skin of this grotesque creature splits open along the back, and out steps the dainty little gnat or mosquito, which, after drying its wings, flies off, to commence (if it happens to be a female) its torturing attentions to man or beast.

As the name "malaria" (meaning "bad air") would seem to imply, one of the earliest ideas was that the disease originated by the inhalation of various noxious gases which are generated in swampy districts. Decaying vegetation was also supposed to be an active cause, as were also great and sudden changes of temperature. The connection of bacteria with the disease was first mooted about the middle of the century, and by later researches has been established without a doubt. The germ or bacillus of malaria was first discovered in 1879, at Rome, by two Italian investigators, and since that time their fellow-countrymen have kept well to the front in the study of this important subject. Although the bacterial nature of malarial fever in its various forms has been thus clearly established for some little time, the method of its dissemination remained a mystery until the startling discoveries due to Grassi, Bignami, and others.

According to Prof. Grassi, the first person to hint at the curious relations between mosquitoes and malaria was an investigator of the name of Laveran, who latterly, however, limited himself to the conception that infection took place through the air or water, at the same time admitting that the bacillus spent some part of its existence in a lower animal or vegetable. Next, Dr. Manson supposed that the germ was normally present in mosquitoes or in some other sucking insect, and that on the death of the latter it would commence a free life in the air or water, entering the human body by inhalation or by the drinking of water. Koch at first held a similar theory, but Bignami went a stage further, and conceived the idea of inoculation by the bite of the insect, which might be a gnat or some allied insect inhabiting damp places. Last year Koch confirmed the American researches, showing an analogy between the behavior of ticks in the propagation of the disease in cattle known as Texas fever and that of mosquitoes in relation to malarial fever, both these diseases being due to bacilli undoubtedly related to each other. Later still, both Manson and Ross have made some interesting communications, the researches of the latter having reference to germs in birds which also have a species of mosquito as intermediate host.

The first thing Grassi set himself to do, therefore, was to find out what species of insect must be considered guilty of spreading the disease. As he tersely remarks, only some species can be culpable, because there are districts notoriously teeming with mosquitoes and yet not infested with malaria, while on the other hand the times or seasons of these insects and the appearance of the disease do not always coincide. By a process of elimination the professor sifted out the species until only a few were left for further investigation as at any rate suspicious. Among the results which followed, the two here given are the most important: (1) three species of gnat or true mosquito must certainly be regarded with great suspicion, and (2) Culex pipiens, whose life-history we have briefly sketched above, must be considered harmless.

With regard to Culex pipiens, Grassi reports that this species is the predominating one in non-malarial districts, while, on the other hand, it is scarce, or even wanting altogether, in not a few districts infested with the fever. Further confirmation of its innocence is also found in the following case cited by the professor, as observed at Follonica, in Tuscany. This region is much infested by malaria, and in the house which serves as hospital for the foundries there the ground floor is set apart for the patients, while the upper stories accommodate the medical staff. In August last, when Grassi visited the place, the only species found there was the one in question, and, in accordance with this fact, we learn that the physicians never had to record the development de novo of a single case of malaria. On the contrary, among the workmen of the foundry who live a little distance away, the cases of fever were in daily evidence. By searching in their houses certain of the suspected species were found, which evidently accounted for the presence of the disease.

Unfortunately, the various species of mosquito have no English names by which they can be distinguished. Therefore, in speaking of the three more particularly concerned in the question now before us, we shall be compelled to use their scientific names. These names are Anopheles claviger, Culex penicillaris, and Culex malariæ. Of these, the first, which we shall refer to simply as Anopheles, according to Grassi, is constantly found in all malarial districts, and is much more frequent where the disease rages more fiercely. It may be distinguished from its relatives by having its wings

spotted, with the spots arranged so as to form a capital letter T. Grassi calls it a "spy" of malaria, and says that the relations between it and the disease have been confirmed in Lombardy, Tuscany, the Roman Campagna, and in many other places. After giving the details of many cases where the disease and the insect either co-exist or are both absent, he refers to a locality near Saronno, where in the middle of a healthy district is a small circumscribed area infested by malaria, and curiously enough, the Anopheles is found there, but not in the surrounding healthy zone. A similar instance occurs near the small lake of Ceriano.

The rice-fields are veritable hotbeds of malaria, and mosquitoes are exceedingly abundant there, too. An exception in both respects occurs near Veniano, where there is a very small rice-field so deficient in regard to its water supply that the rice does not prosper. Grassi found no mosquitoes there, and the medical authorities, likewise, have failed to record the presence of disease in its neighborhood.

Up to the time of writing the first of the three papers we are now summarizing, Grassi only found a single exception to the coexistence of Anopheles and malaria. Near Saronno there is an expanse of artificial swamp containing a few mosquitoes, but cases of disease have not as yet been reported. Considering, as Grassi says, that the swamp is artificial and relatively recent, it can be readily seen that the opportunities afforded to the insects of becoming infected have not been frequent, as, owing to the peculiar situation of the swamp, very few persons have been bitten.

The second species, which bears the name of Culex penicillaris, is also undoubtedly instrumental in spreading the disease, especially in September, when the Anopheles begin to diminish in numbers. This species is more frequent, too, in places troubled by September malaria.

The third species put down as guilty appears to Grassi to be a new one, and he therefore gives to it the very appropriate name of Culex malariæ.

As to the time of day when the insects bite, our author states that the Anopheles prefers to attack within an hour on either side of sunset. In about an hour and a half at this time of day one may be bitten more than a hundred times, while throughout the rest of the day and night not five bites may be received. The second species bites more at twilight than at any other period of the day, as does also Culex malariæ. All these facts fit in exactly with the common knowledge that the twilight hour is the most dangerous one in malarial regions. Moreover, the three species in question, and especially the first, enter houses much more readily than others.

Another important fact is that the mosquitoes of malarial districts, especially the guilty ones, rarely ascend to a great altitude. Therefore, in houses, the rooms of the second and third flats are not visited much by these pests, and this fact agrees well with the well-known comparative salubrity of these higher rooms.

It must always be borne in mind that, in order to produce fever in a healthy person by its bite, the mosquito must itself have previously bitten someone already stricken with illness, and therefore of necessity only a small proportion of the insects can be dangerous, even in a badly infested locality. The greater number of them bite domestic animals, such as oxen, horses, pigs, dogs, pigeons, fowls, etc., as well as man.

One might, therefore, be bitten thousands of times without being inoculated with the bacillus, while, on the other hand, a single bite might be sufficient. These possibilities must be taken into consideration when we read of the failure of the early experiments to demonstrate the actual transference of the bacillus from the blood of the patient to the body of the insect. In a joint note published by the three investigators, Bastianelli, Bignami, and Grassi, they announce that they have been able to follow with certainty certain phases in the development of a bacillus in a portion of the alimentary tract of Anopheles claviger. The specimen examined had been made to suck the blood of patients suffering from malarial fever, and the different phases observed seem to correspond to some described by Ross in the case of a bacterial parasite in birds. In a room where four malarial patients lived, these authorities collected half a dozen Culex pipiens, four Anopheles claviger, and one of another species. The examination of all these insects proved without result, except in the case of two of the Anopheles, which yielded bacilli in the stages of development just alluded to. In an appendix to this communication, the same authors state that they have succeeded in producing one of the varieties of malarial fever in a patient solely through the effect of bites made by this same species. The man was certainly not previously suffering from malaria, and lived in a place certainly free from the disease. They have also obtained, within the alimentary tract of the insect, later stages in the development of the bacillus than those mentioned in the account of their previous experiments.

Grassi records it as his conviction that not only do mosquitoes convey the infection of malaria, but they are probably the only means by which the disease is spread. This is a bold statement, and the author of it answers one or two objections that might be raised against it. One is that cases of malaria sometimes develop in great numbers after a heavy shower of rain. Grassi points out that these may be merely relapses of the fever, and that also before these showers mosquitoes are particularly troublesome. Many cases of malaria were reported to the professor on very high medical authority as having been developed in places free from the presence of mosquitoes. In all the cases he was able to investigate, however, there was unmistakable evidence that the attacks of such insects had intervened.

I might go on multiplying these remarkable relationships to some length further, but must now draw my abstract to a conclusion. In doing so I can only say with the professor, who has furnished the facts and conclusions upon which these remarks have been based, that the investigation of malaria is entering upon a new phase, and we can now indulge a little more than formerly the hope of being able soon to battle successfully with malaria in all its forms. It would not be difficult to make any particular species of mosquito rare in a malarial district by a wholesale destruction of the grubs.

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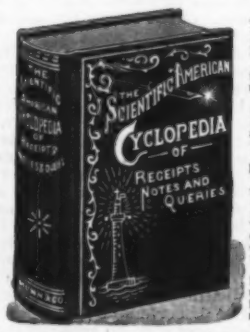

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